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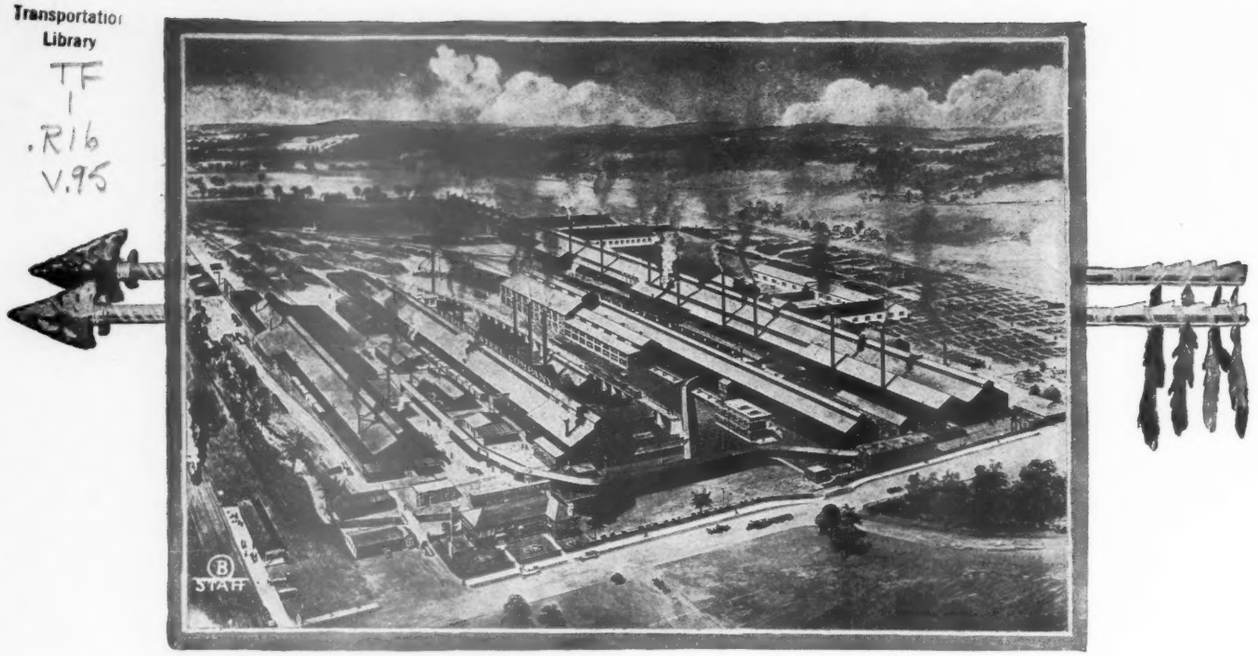

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Railway Mechanical Engineer

Volume 95 January, 1921 No. 1

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There is hardly a phase of railroad operation which does not have some unit of measurement with which may be made comparisons that throw more or less illumination on situations and the trend of events. The real value of these units must be judged, first, by the accuracy with which the results of their use may be interpreted and, second, by the convenience of their application. It is unfortunate that some of those commonly used units have little to recommend them except the latter quality, and among these must be included the per cent of cars in bad order as a measure of freight equipment conditions. The percentage of freight cars in bad order conveys little real information as to the general condition of freight equipment. Neither is it an accurate measure of the amount of work awaiting the shop and repair track forces. This is evident from the fact that bad orders even now are classified as lights and heavies, but with the wide range in the amount of work which may fall in the latter group, the value of this classification for comparative purposes is open to serious question. The cars in bad order may require from four or five to several hundred man hours each, and before this rough classification can be made the estimated amount of work on each car must be known. The information, therefore, is available from which the bad order situation can be stated in terms of car repair hours almost as readily as the number of bad order cars are now roughly classified as lights and heavies. The number of car repair hours conveys an accurate picture of the size of the job facing the repair forces, and the trend of car repair hours will show much more accurately than the trend of the number of bad orders, to what extent the demands for repairs are being currently met. Furthermore, with this information it would be a simple matter to arrive at the number of repair hours per car. This would be a most useful unit, not only for following the trend of car conditions in general, but for comparing cars of one class with those of another in a study of the relative merits of different designs. It does not appear that there should be sufficient added inconvenience in the computation of car repair hours, with the basic data already at hand, to overbalance the value of the information as an aid to a more accurate understanding of freight car conditions.

A Unit That Will Measure

For approximately ten years past the steam pressure used on locomotives has remained practically unchanged. The increase from 140 lb. or 160 lb. to 200 lb. per square inch occurred in a period of a few years. Some roads went to extremes and designed locomotives for 240 lb. pressure, but the investigation of Dr. W. F. M. Goss showed that in a locomotive of a given weight, greater economy could be secured by using a pressure of about 200 lb. than by raising the pressure and decreasing the size of the boiler to keep within the prescribed weight limit. Later when tests with superheated steam proved that the steam consumption per horsepower hour was practically constant over a considerable range of pressure, some roads went back to lower pressures of about 180 lb. to 185 lb. As the diameter of locomotive cylinders has now been increased as much as the clearance on many roads will permit, the next logical step would seem to be an increase in the boiler pressure. In fact this is an inevitable development, for since the stroke of the cylinder and the diameter of the driving wheels are practically fixed, the power output is limited unless the pressure can be raised. The Pennsylvania System adopted a pressure of 250 lb. for its Decapod locomotive and while this is a special case higher pressures

Higher Steam Pressure in Locomotive Service

are likely to be more generally adopted in the near future. Previous experience shows that satisfactory boiler maintenance becomes much more difficult at pressures above 220 lb. per square inch, but when the necessity for higher pressures develops, some means of overcoming it will surely be found though it may lead to the adoption of a different type of boiler for locomotive service.

Responsibility for Heat Treatment

With carbon tool steel at 18 to 25 cents a pound and high speed alloy steel costing around $1.25 a pound, the question of responsibility for the heat treatment of tool steel in railway shops becomes all important. In by far the larger proportion of shops the furnaces, small automatic air hammer, brine baths and other equipment used for dressing and hardening tools is located in the tool-room, but in many cases the tool-maker is responsible to the blacksmith shop foreman for both the quality and quantity of his work. This practice is a mistake. The tool-room foreman should have control of the heat treating department and specify the steel that goes into all tools heat treated at the shop where he is located. Knowing the conditions under which each tool is used, he is the one best adapted to specify the kind of steel needed and the particular heat treatment which will give the best results. The condition of a tool depends upon two things other than the workmanship in its manufacture; namely, the kind of steel as to carbon or alloying elements, and their percentage proportion; the other, the heat treatment. The man doing the heat treating should not be placed under the master blacksmith who often has too many other duties to specialize in the finer art of heat treating tools. In practically every case the manufacturers' recommendations as to the best heat treatment for a particular high speed steel should be rigidly adhered to. The tool foreman, having ordered the steel, is in a position to know what treatment is recommended and should be made fully responsible for the apparatus, methods used and men employed in the heat treating department.

The Conservation of Lumber

Few mechanical engineers appreciate the fact that following labor and fuel, lumber is the largest single item of expense to the railroads. It is quite possible that the unit cost of this material may drop more rapidly in the immediate future than the cost of either labor or fuel; but, in the long run, lumber is certain to increase in price as the available supply approaches a state of exhaustion. This is best emphasized by the fact that approximately one-half of all the available timber in this country is now located in three states bordering on the Pacific ocean. A survey of the records showing the annual rate at which lumber is being consumed in this country is even more startling. As a result of this situation, the railroads are already using grades that not many years ago were thought impossible and it is a certainty that within an equally short period mechanical engineers will be faced with the necessity for specifying grades of lumber for cars and other structures that are now regarded as unfit for this use. But, this being a fact, why should not mechanical engineers anticipate this situation, particularly if the use of a slightly lower grade at this time will reduce the cost of the lumber? In this connection the following is quoted from a paper presented at a recent meeting of the Forest Products section of the American Society of Mechanical Engineers:

"In the early days when the supply of wood in this country was thought to be inexhaustible, clear grades of wood were generally demanded by the car builders, and in the construction of new cars this is generally the practice at the present time, especially for car roofing and siding—sound-knotted stock being used for decking and lining. Some of the more progressive railroads, however, have gone a step further in recent years and many are now using sound-knotted stock for siding and roofing for repair and maintenance work. There is no doubt but that such a practice is economical and based on sound judgment, for certainly there is no necessity for using clear material for the repair of many classes of freight equipment, the life of which may not be in excess of seven to ten years. One large railway system which not only constructs its own cars but does repairing on a large scale, has adopted practice as to grades which has resulted in a saving to this railroad of over half a million dollars per year."

Undoubtedly mechanical engineers would prefer to follow the safe course and specify only those grades of lumber which they know have proved satisfactory. It is advisable, however, that they should do more than this; they should make certain that a less expensive grade will not answer the purpose before committing the railroad to the more expensive grades. This calls for a departure from the beaten path and a degree of courage which, however, should not be lacking.

Advantages of Standard Motion Pins and Bushings

Elsewhere in this issue is an article on "Standard Valve Motion Pins and Bushings" which should be of especial interest and value to railway shop executives and those responsible for the accurate and prompt repair of motion work in machine shops. It is a notorious fact that in repairing locomotive valve gear parts, pins and bushings of almost every possible size are used and the time required for making so many different sizes together with the individual fits, represents a large amount of money at the present cost of labor. The subject of standardization has already received careful attention in certain railroad shops and the article referred to outlines a method of manufacturing and fitting standard grade sizes of motion work pins and bushings with a considerable decrease in cost and increase in shop production. Among the important advantages resulting from the method explained is the fact that it permits manufacturing pins and bushings in large quantities with modern machines at central production shops. By grinding all of the bearing surfaces in one shop, this work can be performed more economically and accurately than heretofore. Most railroad shops are limited in output due to inadequate machine departments and valve work especially is often not completed on schedule time. The advantages of carrying standard pins and bushings in stock finished to the point of turning the taper ends and the outsides of bushings is especially apparent in these cases. Another advantage from the back shop point of view results from the fact that any pin will fit any bushing of the same class. Levers can thus be changed from one locomotive to another without refitting, a condition which is impossible without standard parts.

The Problem of the Railroad Clubs

Addressing members and guests of the New York Railroad Club at the recent annual dinner, the retiring president referred to the excellent character of the papers that had been presented to the club during his term of office. But he also commented upon the lack of discussion following the presentation of these papers and stated that it had proved a most difficult matter to draw out the sort of discussion that is most needed. Those who are best informed upon a subject are often the most reluctant to participate in the discussion, which, as a result, frequently terminates before any additional facts are developed or it drifts into other channels that have no particular bearing on the subject. This is indeed the problem of every railroad club, the real value of whose activities may

usually be judged by the breadth and scope of the discussion. In fact, many papers presented at these clubs are designed mainly to provoke a discussion that will bring out the most salient points in connection with the subject. Since a majority of the papers presented at all the railroad clubs relate to mechanical matters, this situation should be of particular concern to all mechanical men who are so fortunately situated that they can attend these meetings.

Any man who holds decided opinions upon the subject of a paper and has the courage to deliver these views before a body of men, should not fail to take advantage of the splendid opportunity presented at these meetings for accustoming himself to public speaking. If he can deliver his remarks without the aid of notes, so much the better, provided he bears in mind that it is the text rather than the manner of delivery that is most important. In this connection, the activities of the Railroad Section of the American Society of Mechanical Engineers should not only be commended but might well be observed as a model for the railroad clubs. Following the choice of a subject and the selection of a speaker, the committee proceeds to invite a number of the best posted men available to discuss the paper following its presentation. Having secured the acceptance of a sufficient number of men to assure a well rounded discussion, the matter is not allowed to rest but each of these men is advised the length of time available for his discussion of the subject, and subsequent notices are addressed to him in reminder of the meeting. As a result, a broad instructive discussion is developed. In answer to any objection on the ground that this mode of procedure would tend to stifle general discussion of the subject, it may be said that the plan, if it does not involve too lengthy a discussion, will in fact, tend to stimulate more animated general discussion than would occur had no part of the discussion been planned in advance.

Fix Box Cars or Have Them Retired

The outstanding features of recent developments in the car situation, so far as it affects the car department, are the marked increase in the number of cars being returned home and the increasing number of heavy bad order box cars. Between July 15 and November 15 the cars at home increased from 26 per cent to 32.5 per cent of the cars on lines. During the same period the per cent of bad order cars of home ownership increased from 57 per cent to 67.6 per cent of all bad order cars. For box cars alone this increase has been from 46.5 per cent to 63 per cent, and a somewhat similar, though smaller, increase also applies to gondolas. But there has been an appreciable reduction in the number of bad order gondolas, both light and heavy, while the increase of about 8,000 heavy bad order box cars has been only partially offset by a decrease of about 3,500 in the number requiring light repairs. These figures indicate that the large amount of heavy repairs that were made to gondolas during the summer and fall, both in railroad and contract shops, is proving effective, but that the opportunity has only recently presented itself for effectively attacking the box car situation. Such an opportunity presents itself only when traffic is comparatively light, because box cars scatter rapidly when there is a car shortage. It is evident, therefore, that any improvement in the situation must be made now and during the remainder of a period of light business of uncertain duration if it is to be made at all. The need for supreme effort to bring about this improvement before the cars get away from home again is greater than can be inferred directly from the accumulation of bad orders. The retirement of about 135,000 freight cars with replacements probably not exceeding 20,000 or 30,000 has caused a depletion in the supply of equipment, of which probably three-quarters is box cars. This depletion was caused not by deferred retirements alone but by deferred maintenance as well, and should the present opportunity to rehabilitate large numbers of the older cars which are now at home in bad order, be neglected, their retirement from service may become compulsory before another opportunity to salvage them is offered. The railroads can ill afford any further extensive depletion of the box car supply during a period of heavy traffic until deliveries of new cars have become extensive enough to greatly outnumber the retirements.

The Labor Policy of the Railway Mechanical Engineer

Among the Letters to the Editor in this issue there appears a communication from a subscriber who evidently feels that the policy of the *Railway Mechanical Engineer* in regard to labor matters is unfair to the workers. While some of the statements made are apparently based on a misconception of the intent of the articles to which they refer, they are printed in full, as a few comments on the letter should serve to bring out clearly the editorial policy on this important subject.

The entire tone of the letter indicates that the writer feels that labor conditions were uniformly bad prior to federal control and the only hope for the employees in the future lies in the adoption of the Plumb plan. The autocratic stand taken by some railroads in the past is criticized. It must be admitted that abuses existed, but they also existed in other industries at the same time. Labor conditions in general have improved in the last few years and the railroads have developed their policies in accord with the spirit of the time.

The right of the employees to have a voice in fixing wages and working conditions is now generally conceded. This right is assured to the railway workers under the Transportation Act. The form which employee representation should take is a matter that should be left open to be determined by the management and employees on each individual railroad. Certainly the close contact between the management and the workers necessary for harmonious and efficient relations will not be promoted by the centralization of authority in national boards of adjustment. Granting the right of the employees to organize, the employers on the other hand have a right to demand that each employee shall give a fair day's work, that working agreements shall be so framed that they do not hamper production without cause and that promotions to supervisory positions shall be based not on seniority but on ability.

The section of the letter dealing with the Plumb plan compares it with the present Transportation Act. The writer makes a statement that the railroads are guaranteed a definite rate of return, but this has been disproved so often that it hardly seems necessary to point out once more that the return is conditional on the efficient operation of the property. The statement that interest is paid on watered stock is equally misleading. The value upon which the earnings are based is determined by the Interstate Commerce Commission. With the data obtained in the federal valuation reports the commission is certainly in a position to decide on a fair value for the property of the carriers.

To deal with all the questions brought up in the letter would make this article too long, but some of the statements regarding the present attitude of the railroads toward their employees can hardly be passed by without comment. To complain because the railroad managers did not acquiesce in all the demands made by the employees of the labor board hearings seems unreasonable. The Transportation Act places responsibility for efficient operation on the management, but it would hardly be consistent for them to claim that they were managing their property efficiently if they advocated fixing rates for labor higher than the prevailing scale in other industries. As a matter of fact, the railroads

recommended that some classes of employees be given the full amount of the increase which they requested.

The concluding paragraph of the letter discloses a lack of knowledge of the fundamentals of economics that is responsible for much of the labor trouble at the present time. Wages, prices and business conditions are not manipulated by any small group of individuals, but are determined by fundamental economic laws. The employees and the managers have far more interests in common than is generally realized. The hope of improved conditions in the future lies in the more general realization of these mutual interests and the development of a spirit of co-operation instead of antagonism. A masterly treatment of this question will be found in the address by Herbert Hoover published in this issue, which outlines a program for industrial and social progress that should appeal alike to employer and employee.

NEW BOOKS

The Engineering Index for 1919. Published by the American Society of Mechanical Engineers, 29 West 39th street, New York. 527 pages, 6 in. by 9 in. bound in cloth.

The purpose of the Engineering Index is to provide a convenient and satisfactory guide to engineering literature. The 1919 edition of this index is the most complete and comprehensive work of its kind ever published. It contains over 12,000 references to articles published during the year 1919 in nearly 700 engineering and allied technical publications. The compilation of this index is based upon a review of approximately 1,100 periodicals, reports, and other publications by the engineering staff of the American Society of Mechanical Engineers. These publications are printed in ten different languages and comprise what is probably the most complete collection of scientific and engineering publications in the world. All of the publications referred to in this index are now a part of the Engineering Societies Library in New York.

Fuel Oil In Industry. By Stephen O. Andros. 240 pages, 6 in. by 9 in. Illustrated. Bound in cloth. Published by the Shaw Publishing Company, 910 South Michigan Boulevard, Chicago.

The use of fuel oils by the railroads is by no means new and the problems involved in its application to the locomotive have been carefully studied by railway engineers for many years; in fact, the value of this book to the railway mechanical or civil engineers might be questioned if it were not for the tremendous expansion in the use of fuel oil in all industries within recent years. Thus the increased price of bituminous coal has assisted in promoting the use of fuel oil both in maritime service and in many hundreds of stationary plants along the eastern seaboard. This in turn has introduced new problems relating to its transportation in bulk and storage in large quantities. Moreover, it must be admitted that refinements bearing upon the handling and burning of fuel oil are generally given more consideration in stationary and maritime service than in railroad use. For this reason, there is a field for a book of this character in railroad as well as industrial service which outlines, as it does, not only the principles of fuel oil combustion and the properties of fuel oils; but the methods of testing, storing and burning it together with a full description of its application to industrial and domestic furnaces. For instance, the book not only describes many of the details involved in the construction of steel storage tanks but refers to an interesting development in concrete oil storage tanks and describes at length all of the pipe setting and auxiliary machinery involved. While the book describes many types of burners that would not be applicable to locomotive service, still there are many points in connection with this subject as outlined in this book that will prove of particular interest to railway fuel engineers. The use of fuel oil in the manufacture of iron and steel and the heat treating furnaces is also described and illustrated in an interesting way.

Export Register of the Federation of British Industries. 328 pages and catalogue section of 312 pages, illustrated, 7 in., by 9½ in. Bound in cloth. Published by the Federation of British Industries, 39 St. James street, London, S. W.-1, England.

The trade organization movement in Great Britain has made great progress in recent years. One of the most notable recent developments was the inauguration of the Federation of British Industries in the summer of 1916. This body has enrolled 1,300 members including 200 trade associations. The Export Register recently published by the federation is probably the most comprehensive directory of British industrial firms yet prepared. The industries are divided into 20 groups which are in turn subdivided according to the specialized branch of the industry which the producer serves. A list of companies, firms and their agents, with sufficient information to enable the buyer to get in touch with the nearest agent, is given. Another section of the book is devoted to a very complete list of products with the names of the manufacturers represented in the federation. An extensive section devoted to advertising enables the individual manufacturers to give further information concerning their wares. This book might well serve as a model for American export associations in furthering their interests in the foreign field.

The Locomotive Up to Date. By Charles McShane. Revised edition, 893 pages, illustrated, 6 in. by 9 in. bound in cloth. Published by Griffin & Winters, Chicago.

The remarkable development of the locomotive and locomotive appliances which has taken place since this well known book first appeared in 1899, made a revision imperative if it were to continue to be of current interest. This work has been performed by Charles L. McShane. The book is non-technical in character and in many respects perhaps too superficial in its treatment to be of value to any one but a novice in locomotive design, maintenance or operation. Its great appeal will probably be to the young machinist and the apprentice, and perhaps to some extent to the locomotive fireman. By far the greater part of the space devoted to descriptive material is taken up with locomotive specialties rather than with the construction of the locomotive itself and the revision has consisted largely in bringing these sections up to date. So many of the more recently developed locomotive appliances, some of them well established, are so lightly touched, if touched at all, that the volume can hardly be said to justify its title, even in the field to which most attention has been given. In the revisions of those sections dealing with breakdowns and shop work no account has been taken of the requirements or effects of the Interstate Commerce Commission locomotive inspection rules and the revision has failed to disguise the fact that these sections are most directly applicable to the motive power of 20 years ago. Over one-third of the volume is devoted to valves and valve motions, and the sections dealing with these subjects are the most thorough and complete of any in the book. The fundamentals of valve motion and the determination of valve proportions and events have been thoroughly handled in so simple a manner that they may readily be comprehended by the novice while still offering much of interest to those of greater experience. All of the valve motions now used in locomotive service are described and instructions for valve setting are given in each case. From the standpoint of the young machinist, only second in importance to the sections dealing with valves will be found those on shoes and wedges, the laying out and fitting of which have been fully explained, numerous sketches adding to the clearness of the explanation.

COMMUNICATIONS

The New Haven Mountain Type Locomotives

NEW HAVEN, Conn.

TO THE EDITOR:

I noticed with considerable interest the description of the Mountain type locomotives for the New Haven and at the same time I have observed a few things that are not absolutely correct. This article states that engines were equipped with a Unit drawbar. This is not true, as it was necessary, by reason of design, to forego the use of the Unit drawbar. It is also stated that the Lewis power reserve gear is used, whereas the locomotives are equipped with Ragonnet, Type *B*. Moreover, the cylinders were not cast with by-pass valve chambers as stated in the last paragraph of "changes in the standard design."

On the same page, second column, it is stated that the object of designing a single hopper ash pan was to facilitate future application of the booster. While in a measure this is true, it was also found possible to increase the capacity of the pan approximately 15 per cent over the government design and at the same time dispense with necessity for two hoppers.

J. C. HASSETT,
Mech. Engr. N. Y., N. H. & H.

The Union Viewpoint on Labor Questions

SAN ANTONIO, Texas.

TO THE EDITOR:

I find an article in your November issue in which the writer says much will have to be done before we get back to pre-war conditions. As a representative of labor, I beg to inform him that the workers have no intention of going back to pre-war conditions, now or at any other time, as we suffered too many hardships under those conditions. We have therefore formed ourselves into different organizations and made ready to protect ourselves and our families from the employer who would have us work for a bare living under whatever conditions he saw fit to impose.

We fully understand that pre-war conditions means that the employer wishes again to have undisputed control over his employees, to deal with them as he sees fit, regardless of what they may want or desire; in other words, he wants them to become automatons, without the right to think for themselves.

We can all remember the time when the workers first asked for the eight hour day, how these same men told the public that the eight hour day meant the destruction of the country, and again when the nine hour day was forced upon them, they tried to make the public believe that the workers were trying to destroy the commerce of this country by not producing enough to supply the demand. Now we have the eight hour day and wages which allow us some of the comforts of life and a chance to give our children an education which before we were compelled to deny them.

We find that according to the newspapers the workers are again about to destroy the universe in which they live, but we have lived through the signing of the Declaration of Independence, the abolition of slavery, the establishing of prohibition, woman suffrage, and we will allow the workers to get their rights without destroying the country or even being sorry for any of these changes for the betterment of mankind.

This writer complains that the shops are burdened with a class of men who claim to be mechanics, but who are not able to produce a day's work for a day's pay. The most of these men were employed in these same shops before the war and were classed as handy-men; their wages averaged very little more than that of the common laborer. They were trained by their employers in order to get cheap labor, instead of paying mechanics to do mechanical work. The employers insisted on using these men as long as they could get them for small wages and force them to work under conditions that no mechanic would tolerate. Now that these men are demanding that they be paid a living wage, he has no further use for them, but wants to throw them out until such time as they have been starved into submission and the acceptance of a lower wage, or he would be even willing to use them as he has in the past as a strike breaker, in case his mechanics get too bold and demand their just share of the profits of the business of which they are the most vital part.

When the railroads went under federal management there was established a sliding scale of wages for this class of employees; under its provisions a man became a full rated mechanic after he had worked four years at a trade. If the management had done their part and given these men a chance to learn all branches of the trade during this four years, they would have had nothing to complain about at the present time. They made no effort to train these men, and now they find themselves confronted with the problem of making these men earn their salary, when they are only able to do one class of work.

I find these men very anxious to learn and make something of themselves and using every means in their power to make themselves mechanics. Some even go so far as to quit the shop and go to a strange shop and hire out as a mechanic, working as long as they will allow him, and then going to some other place where he is not known and repeating the same thing, until at last, after many hardships, he is able to hold a job. These are the men the writer complains about and asks the mechanics to allow them to turn them out on the streets.

I believe these shops owe it to these men whom they have started to make mechanics of to allow them to finish their trade in the shop where they started and where the employer received the benefit of their cheap labor before the war. Make them proficient workmen; give them mechanics' pay, and then stop making jack-leg mechanics and handymen.

The railroads are asking that they be allowed to deal with their employees individually, but they are not willing to be dealt with individually; they still want to be guided by their organizations and be banded together as one body in dealing with the employees; we want a fifty-fifty deal, that's all.

In the other article to which I take exceptions we find this statement, "Under the Plumb Plan the public would buy the roads and guarantee their operating expenses and the interest on the money invested in them."

Under the present plan we are not buying the railroads, but we are guaranteeing the operating expenses, and the interest on not only the money invested, but also six per cent on the watered stock. In this way the public is assuming all the risk and getting absolutely nothing in return.

The statement is made that under the Plumb Plan the surplus money earned would be divided, one-half going to the workers. How about the present plan; what will become of the surplus earnings? Will the worker get their share, or will the public get any of it, or will it be as it has been in the past: the favored few stockholders adding a little more watered stock and getting away with the cash? This article claims that no business is well managed unless it is handled by the owners or in their behalf. How, then, are we to account for the many successful enterprises now being run under municipal management? We find cities running water works plants, street cars, light plants and many others too numerous to mention, and they are paying better than they did under private management. Besides,

the employees are better paid than they were under private control.

As an instance of this I beg to call your attention to the city of Cleveland where a few years ago the city was taxed to pay for the collecting of the garbage, while at the present time, under municipal management, the city receives several thousand dollars by the sale of its garbage, besides having it collected free to the public.

The language of this article would lead one to believe that the last increase in pay granted the railroad men was given by the private owners, whereas they used every means which they had in their power to prevent the men getting this increase.

The claim is made that this shows that the men would be able to get just treatment under private management, but their actions in the past, to say nothing of the present, does not bear out this claim. In the past the men were forced to work piece work, premium work and bonus work and goodness knows what else, no matter how much they protested against it.

During federal control these things were done away with by the vote of those who were trying to exist under these systems, and this vote was so strong in favor of abolishing these methods that the government granted the request of the employees.

Since the roads have gone back to private control they are using every means in their power to reestablish these old practices, which the men who work in the shops have said they do not want.

You state that it would be possible for the men to own the roads by simply buying up the stock of the different roads. My experience has been that some of the large roads have tried this plan to get control of smaller side lines, which they needed as feeders for their main lines. If history is correct in its statement on these deals, and I believe it is, they found this not only an expensive proposition but often an impossibility, as the stock markets are not so easily handled as this statement would lead us to believe.

The money to make this purchase possible is to be taken from the last increase in wages which the workers received, but it is a well known fact that this increase was only granted after it was conclusively shown that the men were not able to live on the wages they were receiving, yet they must take this money and buy the roads and deny themselves the necessities of life. This is called thrift, but it is the kind of thrift we always want the other fellow to practice but do not care to indulge in ourselves. The writer sees in the failure of the employees to do this proof positive that they would not be able to run the roads if they were given the chance. He overlooks one essential point, and that is that the owners do not run the roads but hire men to do it for them. We find that few of the men who are held responsible for the running of the roads own any of the stocks of the road they are managing. We well know that when there is any question of any consequence to be settled it is the men who are paid a salary that are called upon to handle it and not the owners. It is the brains that a road is able to buy that makes it a success or failure, not the brains of the men who own the stocks. The owners are more concerned about the price of the stocks and the amount of their dividends than they are about the way their roads are run, except as an investment.

The managers are trying to make the public believe that the workers are being paid too high a wage. Did you ever stop to think why wages were so high? Most of the men who own the greater part of the railroad stocks are also owners in part of some other business which was responsible for these high prices of which we all complain. Then they must be responsible for the high cost of living and also the high cost of labor of which they are now complaining. They are even now trying to create a bread line to reduce the price of labor and make the worker submissive to their will.

L. S. KRONHEIMER,
Chairman, Local Federated Shop Crafts, G. H. & S. A.

Management in Railroad Shops

SALT LAKE CITY, Utah.

TO THE EDITOR:

The editorial on Systematizing Management in Railroad Shops, published in the November issue of the *Railway Mechanical Engineer*, deals with a subject of the utmost importance. I believe that a close study of this question will lead to the conclusion that job analysis and job specification, carried on by a competent committee of both officers and employees, and under the supervision of a personnel department is the only logical solution. The committee on job analysis should be composed in part of mechanical officers who would work with a committee appointed from each shop on the line, and in this way the benefits derived in one shop would be passed on to all the shops coming within the sphere of the study. One of the chief values of this plan would be that a certain number of employees would gain first-hand knowledge of the work and would have a chance of expressing their views of any changes that might be recommended that would affect the employees. These objections would receive due consideration and for this reason all employees would more readily accept any changes in method that might be adopted.

I have also read with interest the editorial on page 683 entitled "Training the Foreman." To my mind the foreman is the key to the whole problem of efficiency and safety. Every large shop at least should provide a definite and systematic training course for all of its foremen. This work should have a competent instructor in charge of it, and the course of instructions should not only provide courses in the mechanical details of the foreman's work, but should be designed to develop executive ability and give the foreman a larger outlook on the transportation business as a whole. This work should also be under the general supervision of a personnel department.

J. C. CLARK,
Asst. to General Manager in Charge of Safety, Oregon Short Line.

Save Fuel by Keeping Valves Square

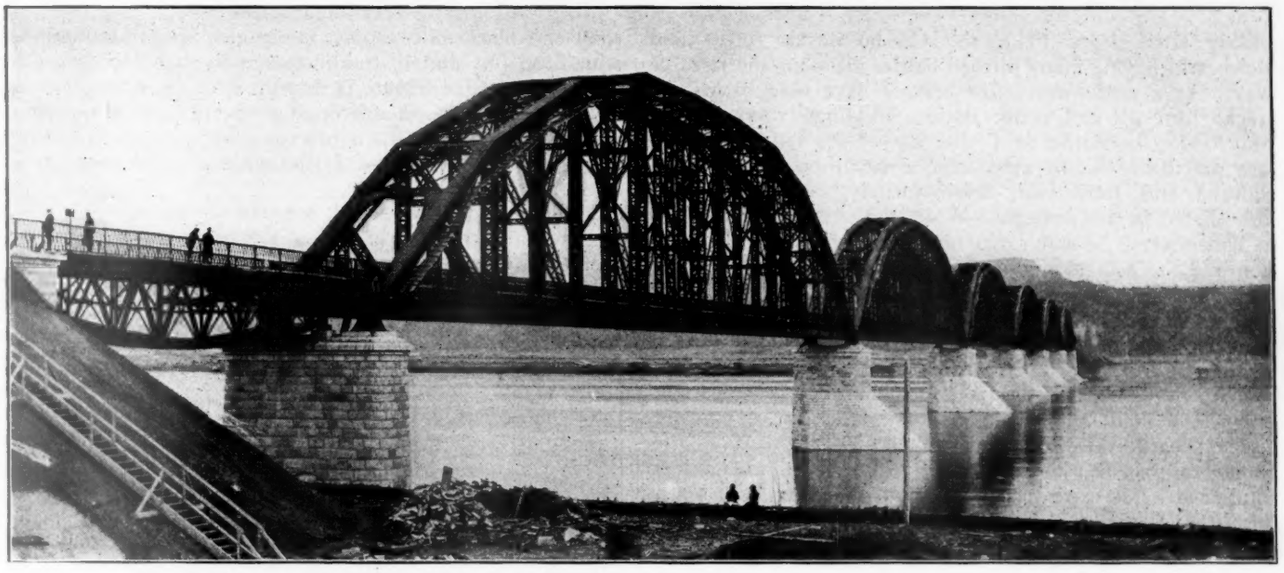
HEATH, Mass.

TO THE EDITOR:

Why is not valve setting given more attention in large engine terminals? Much money is spent, and rightly too, on the upkeep of devices for economy in the production of steam but little attention is given to the device that determines the economy secured in the use of steam; namely, the valve gear. With pooled engines, very often a locomotive out of square will not be reported as requiring attention in that respect, or an engine may be out of square and yet handling its train all right and so nothing is done. Then there is the rarer case of an engine sounding square but in reality being out.

The effects of a lame engine on fuel consumption are so well known that it is unnecessary to repeat them. But a point often not realized is the tendency of a lame engine to slip. This results in difficulty in starting and liability of stalling on a hard pull. The valve setting should be checked on each engine regularly. In the larger terminals, a valve setter and helper could probably be kept busy squaring valves. An engine should be inspected after perhaps 20,000 miles. In a good many cases where there is much lost motion and the engine has considerable mileage to cover before the next visit to the back shop, it would pay to renew bushings in the valve gear and thus have the valve move as intended and not lag.

W. G. LANDON.



Bridge on the Tomsk Railway Crossing the Yenisee River at Krasnoyarsk

Mechanical Equipment on the Tomsk Railway

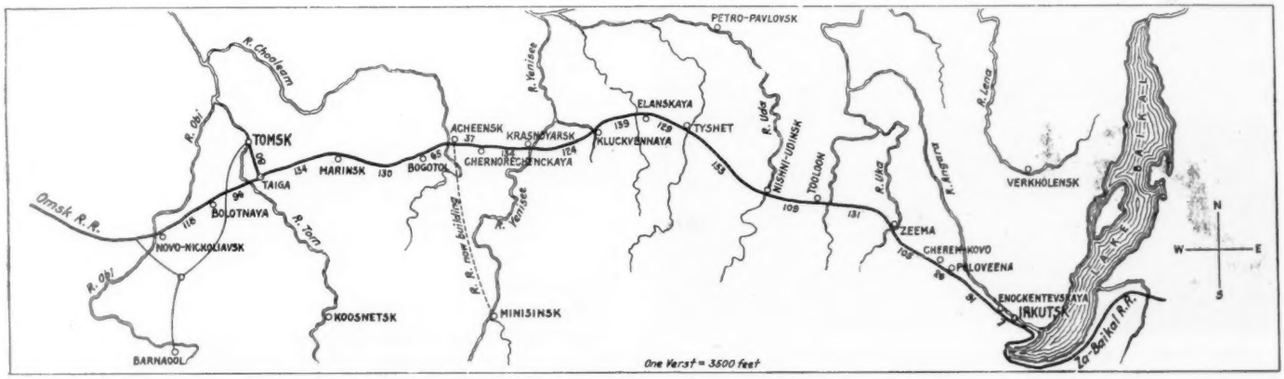
An American's Impressions of the Locomotives. Cars and Shops of the Trans-Siberian System

BY JAMES GRANT
Late Captain, Russian Railway Service Corps

THE Tomsk railway is that part of the Trans-Siberian system, between Irkutsk and Novo-Nickoliavsk. The main line is all double tracked, a distance of 1,734 versts. As one verst is 3,500 ft., this is, in English units, approximately 1,156 miles. There are very few branches, the most important being the branch from Tiaga to Tomsk, about 80 versts long. There is a line in course of construction from Achinsk to the city of Minisinsk. By glancing at the map of the railroad it will be observed that Achinsk, which is a small town, is about 170 versts west of Krasnoyarsk, while Minisinsk is an important city about 250 versts south of the railroad, on the Yenisee River. This latter city was always a Bolshevik stronghold, an army of 15,000 being stationed there all the time that the Kolchak forces controlled Siberia. The Kolchaks were never able to oust them from Minisinsk because the town was too far away from all transport facilities. The road connects with the Za-Baikal at Irkutsk and the Omsk Railway at Novo-Nickoliavsk.

The section through which the Tomsk railway runs is perhaps the most fertile and productive region in all Siberia. The scenery along the road is very pretty, consisting of fine agricultural districts, coal mining concessions and dense forests. The road crosses great rivers and runs directly through the wealthy Yenisee province. This province was always known as one of the most independent in all the old Romanoff's broad domains. Considering the past years of revolution, the roadbed is in excellent condition; it is all ballasted and has 72 lb. rails. The section work at the time the American forces were in Siberia was done mostly by women, nearly all men of fighting age being engaged either with the old Russian army or the Bolsheviki.

This sector of the country has been the scene of much



Map of the Tomsk Railway Showing Distances in Versts Between Principal Stations

bloody strife since 1917, the Czecho-Slovak forces and Bolsheviki having many pitched battles all along the right of way. As a result many fine bridges have been blown up, tracks torn up and many station buildings wrecked. In May, 1919, the station at Tyshet, one of the main terminals, was practically blown away after a battle between Czecho-Slovaks and Bolsheviki, approximately 200 Reds being annihilated in this struggle. While the writer was stationed at Krasnoyarsk he saw seven train wrecks between that station and the next terminal in one week of September, 1919. These wrecks were all caused by Bolsheviki pulling out rails, usually wrecking Russian military trains, resulting in much damage to the motive power and invariably causing quite a loss of life. At this time there is a sad collection of equipment in the ditch, awaiting some semblance of order so that it can be brought to the shops and be rebuilt.

The Tomsk railway has always been recognized as the banner railroad in Siberia, especially in regard to mechanical equipment. The road has seven main terminals, with seven turn-around terminals located between. The terminals and verst posts are as follows:

Irkutsk (Terminus of Za-Baikal Railway)	0 v.
Enockentevskaya	7 v.
Poloveena	98 v.
Zeema	235 v.
Tooloon	366 v.
Nishni-Udinsk	475 v.
Tyshet	628 v.
Elanskaya	757 v.
Kluckvennaya	896 v.
Krasnoyarsk	1,020 v.
Chernorechenskaya	1,154 v.
Bogotol	1,256 v.
Marinsk	1,386 v.
Taiga	1,520 v.
Bolotnaya	1,616 v.
Novo-Nickoliavsk (Terminus of Omsk Railway)	1,734 v.

The stations shown in italics are main terminals.

Elanskaya is the station at which Colonel Blunt and six other American engineers were captured by the Bolsheviki while endeavoring to evacuate eastward towards Vladivostok in January, 1920. The writer left Colonel Blunt and his party at Krasnoyarsk on December 19, 1919, and it took seven weeks to make the trip to Vladivstok, a distance

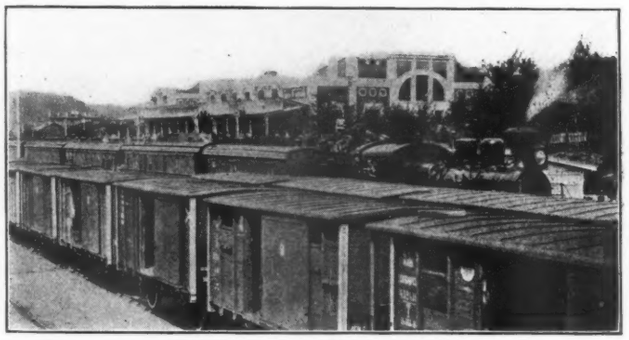
A Train at Vladivostok Station

of 4,036 versts. The remainder of the engineers started evacuation eight days later, but only got as far as Elanskaya, where they were captured. They were, however, later turned over to the Czecho-Slovaks, who had their echelons strung out all along the line, trying to get to Vladivostok.

Terminals

Each of the main terminals on the Tomsk railway is well equipped, usually having large and commodious yards. The engine houses generally consist of two rectangular sheds with capacities for about 50 locomotives, a rectangular shop for nine engines (in which all light repairing is done), machine shop and blacksmith shop. The engine sheds are equipped with drop pits and hydraulic traversing rams for dropping wheels. One fine feature is that the drop pit rails all swing on hinges, so that when dropping wheels there is no lifting of heavy rails. All shops are equipped with electric hoists of the same type as used in the main shops and described later in this article.

Main terminals have both a turntable and a "Y," while turn around stations have a "Y" only. Turntables are operated by an ingenious air device, connected to the train line on the engine or tender. This consists of a horizontal air cylinder with a clamp attached to the piston, so designed



Station at Pograneechnaya, Showing Type of Freight and Passenger Equipment

that it seizes and releases the rail, as controlled by the operator with a three-way valve. This device, while probably not as good as some of the air driven attachments in this country, works surprisingly well and extreme cold weather causes it very little trouble.

Motive Power

The road has between 500 and 600 locomotives in operation, and these engines are composed of seven distinct types only, as follows: 1. 0-6-0 or Switcher type. This is the so-called government type of locomotive, so common in Russia. These engines were built in 1893 and 1896 by the Putilov works of Petrograd. There are only a few of this type on the road and they are used for switching service. The principal dimensions are:

Weight on drivers	34.50 tons
Total weight, engine and tender, loaded	60.10 tons
Diameter of drivers	1,292 m.m. (52 in.)
Length of engine and tender, overall	14,313 m.m. (47 ft. 0 in.)

2. 0-8-0 or Eight Wheel Switcher. The road owns about 200 of this type. Most of them, however, are stored away out of service, replaced by more modern power. They were built at different times, between the years 1895 and 1906, by seven different locomotive works in Russia. They are generally used for switching. The principal dimensions are:

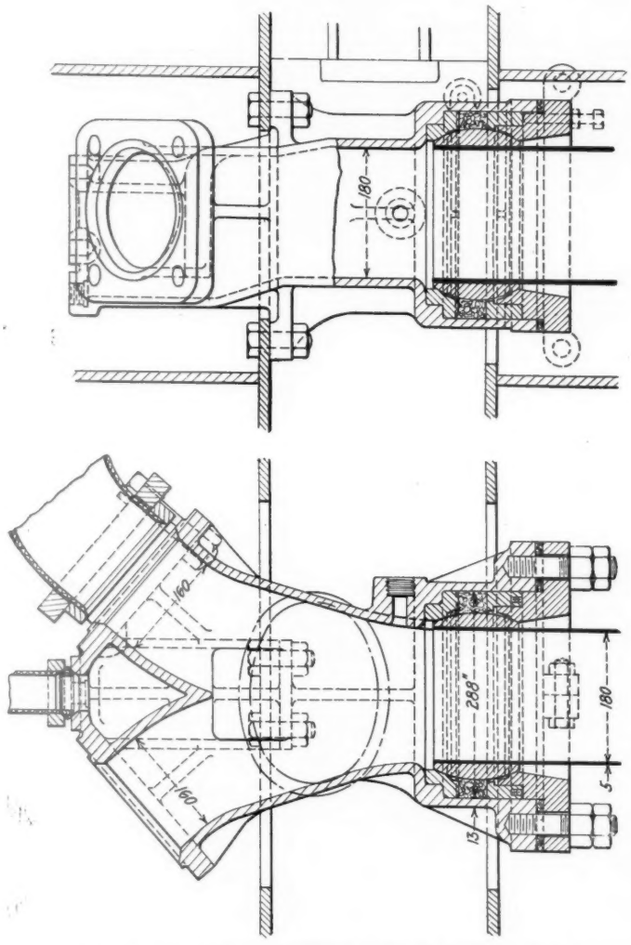
Weight on drivers	51.5 tons
Total weight, engine and tender, loaded	103.03 tons
Diameter of drivers	1,200 m.m. (47.3 in.)
Length of engine and tender, overall	18,691 m.m. (61 ft. 5 in. app.)

3. 0-6-6-0 Mallet Articulated. The road owns about 230 of this type of locomotive, which is one of the most successful for freight service on the whole Trans-Siberian system. Although not so large as our American Mallets, yet they have many noteworthy features. These engines were built between 1899 and 1906 by the Bransk, Putilov and Kolomensk locomotive works. They have slab frames (as have all Russian built locomotives) of 1¼-in. plate, and breakage is a thing unknown. The high and low pressure engines are connected by upper and lower steel castings, riveted to the frames, and hinged on two 4½-in. pins, brass bushed. The driving box jaws are bolted or riveted to the frames, so that they can be removed and machined, when the engines undergo repairs. The driving box shoes and wedges are made of steel, while

the box faces are brass lined. The receiver pipes have both ball and sleeve joints of special construction, as shown in the drawings, which are so designed that there is little trouble from steam leakage. The engines have Walschaert valve gear, piston valves, fire boxes and flue sheets all made of copper, with copper stay bolts, and a special type of Freidman injectors. The principal dimensions are:

Weight on drivers	84 tons
Weight of engine and tender, loaded	135 tons
Diameter of drivers	1,200 m.m. (47.3 in.)
Diameter of H.P. cylinder	475 m.m. (18.7 in.)
Diameter of L.P. cylinder	710 m.m. (28.0 in.)
Diameter of H.P. and L.P. piston valves, both	300 m.m. (11.8 in.)
Length of stroke	650 m.m. (25.6 in.)
Maximum steam pressure	12 atmospheres (176 lb. per sq. in.)
Length of engine and tender, overall	21,097 m.m. (69 ft. 3 in. app.)

4. 2-4-4-0 Mallet Articulated (used for passenger service). The road has 112 locomotives of this type built between 1903 and 1909 by the Kolomensk Locomotive Works. These engines are quite similar in design to the freight Mallets, and can get over the road with remarkable speed. The principal dimensions are:



Tee and Ball Joint on Receiver Pipe of Russian Mallet

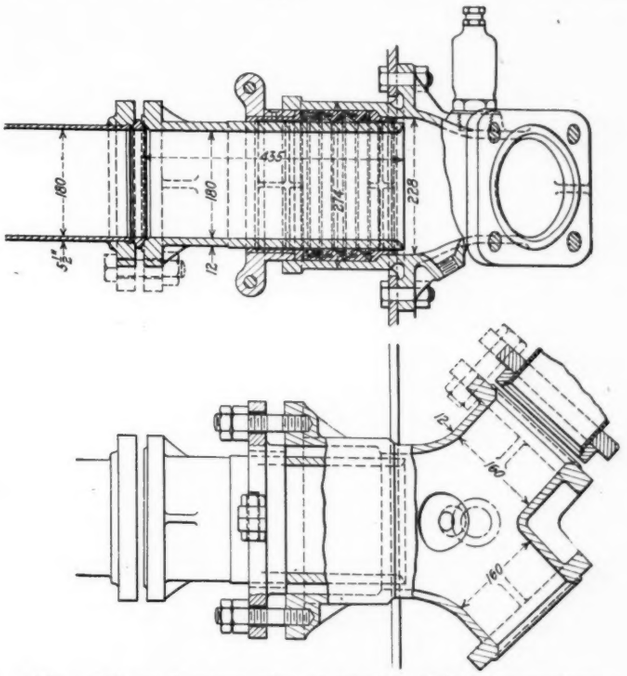
Weight on drivers	65 tons
Weight of engine and tender, loaded	116.07 tons
Diameter of drivers	1,350 m.m. (53.2 in.)
Length of engine and tender, overall	19,723 m.m. (64 ft. 9 in. app.)

5. 2-10-0 American Decapod (built by the Baldwin and American Locomotive Works between the years 1913 and 1916). The road possesses about 50 of these engines. Their tonnage on the Tomsk railway is rated just the same as the freight Mallets. They have a Schmidt superheater and carry a steam pressure of 12.7 atmospheres (187 lb. per sq. in.). A description of these locomotives has appeared in a former issue of the *Railway Mechanical Engineer**. Many of this type, built for the Russian government, are now operating in this country.

6. 2-6-2 or Prairie type (used in passenger service). The road has 13 of these locomotives, built in 1915 by the Sormov Locomotive Works. These are a fine passenger engine and compare favorably with any of our American power. Equipped with Walschaert valve gear, and Schmidt superheaters, carrying a steam pressure of 13 atmospheres (191 lb. per sq. in.) they are capable of great speed. They have a special design of piston rod packing, using a double packing ring. Officials claim that this packing runs from shopping to shopping, without renewing. It seldom blows even in the coldest of weather. The principal dimensions of this class are:

Weight on drivers	47.1 tons
Weight of engine and tender, loaded	126.3 tons
Diameter of drivers	1,830 m.m. (72.1 in.)
Length of engine and tender, overall	21,271 m.m. (69 ft. 11 in. app.)

7. 4-6-0 or 10 Wheel type (used in passenger service). The road has 44 of this type, built in 1910 and 1911 at the Kolomensk and Putilov works. They are quite similar in design to the Prairie type being equipped with Walschaert valve gear and Schmidt superheaters and carrying a steam pressure of 12 atmospheres (176 lb. per sq. in.). The principal dimensions are:



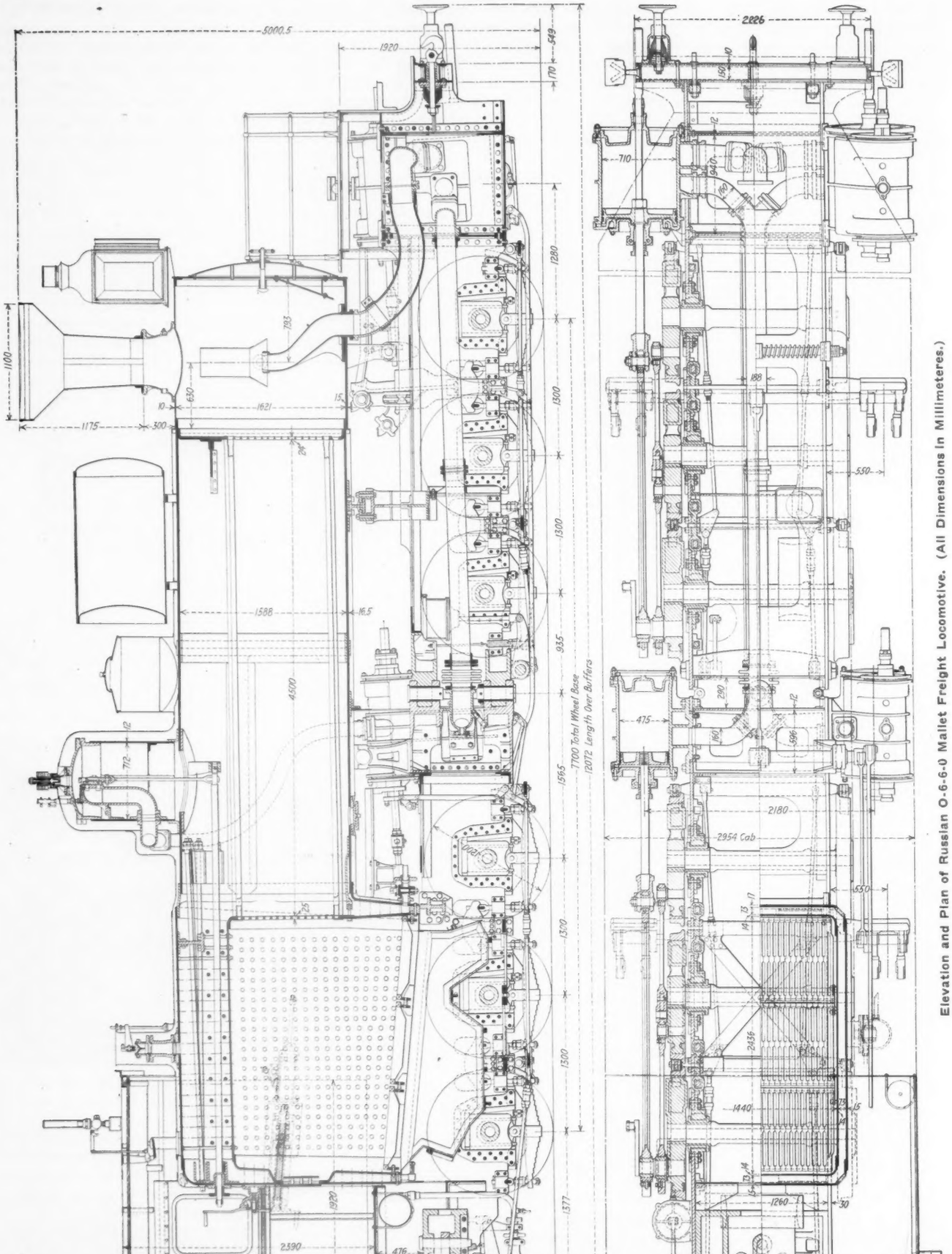
Slip Joint on Receiver Pipe of Russian Mallet Locomotives

Weight on drivers	46.5 tons
Total weight, engine and tender, loaded	124 tons
Diameter of drivers	1,700 m.m. (67.0 in.)
Length, engine and tender, overall	19,689 m.m. (64 ft. 8 in. app.)

An engine crew consists of three, an engineer, assistant engineer and fireman. Many women now work as firemen, there is such a scarcity of able-bodied men. The engineers as a rule are bright, capable fellows, highly trained in their occupation. It is a rule that all engineers running a locomotive, must first serve an apprenticeship in the shops so they are thus taught the repairing and upkeep of locomotives. Afterwards they graduate as firemen, assistant engineers, then first engineers, an examination being necessary before being promoted to a higher grade. The statistics often given that 60 per cent of the Russian working people are illiterate certainly does not apply to the railroad workers.

A train crew usually consists of about five men, a chief

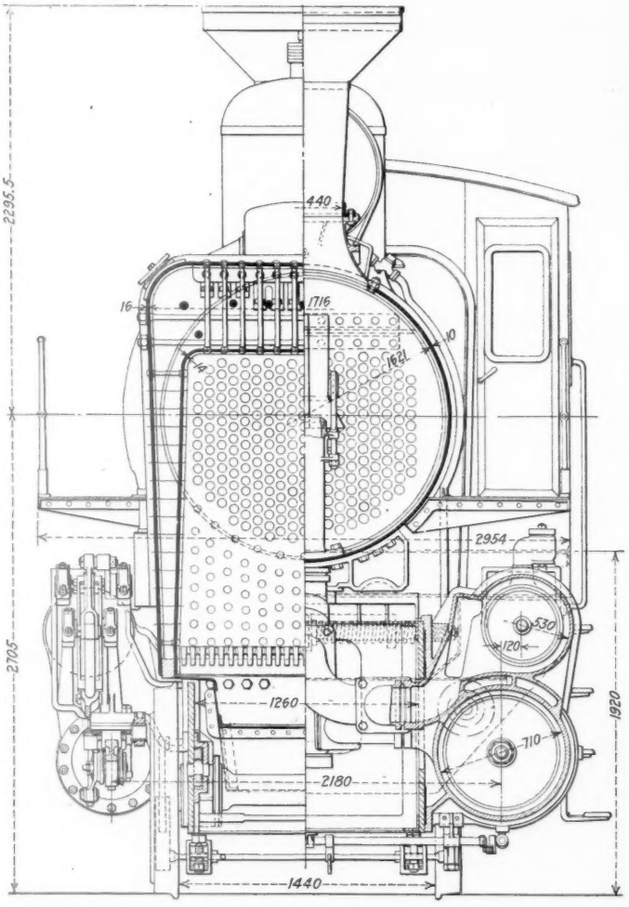
*Issue of October, 1917, page 545.



Elevation and Plan of Russian O-6-6-0 Mallet Freight Locomotive. (All Dimensions in Millimeteres.)

conductor and four assistants. This number, however, varies according to the tonnage of the train. There are no air brakes on the freight cars, hence about every tenth car is required to be a brake car, and is manned by one of the assistant conductors. The tonnage of the usual train is 60,000 poods, or about 1,000 tons. On certain sections of the road helper engines are necessary, but the grades as a rule are very slight. Riding these open brake cars in winter is a strenuous occupation. Quite frequently the thermometer goes down to 60 degrees below zero and stays there for months. The road furnishes brakemen with big fur lined coats and high felt boots, which are very necessary for the Siberian winters.

The rolling stock is the usual type of equipment seen in Russia. Passenger coaches are divided into first, second, third and fourth classes. Passenger coaches are much run down on account of lack of attention, the provodneeks or



Cross Section of Mallet Freight Locomotive, Tomsk Railway

porters being lazy and discipline lacking. Coaches are all built with coupes to accommodate two or four people, and a corridor runs along one side.

The freight equipment consists mostly of tepluskas or four wheeled box cars, with a capacity of 1,000 poods or 16 tons, all with turnbuckle couplers. However, many of the American 3,000 pood or 50 ton gondolas are now in operation on this road, and it is doubtless only a question of a few years when the small cars will be superseded by those of larger capacity.

Fuel is obtained from two different sources located near each end of the road. Large coal mines are operated at Cheromkovo, shown on the map about 100 versts west of Irkutsk and near Tiaga, about 200 versts east of Novo-Nickoliavsk. A good grade of lignite coal is obtained, and there is a plentiful supply at different points along the road, although only these two sources are worked by the railway. It was at Cheromkovo that the Social Revolutionary party sprung up in December, 1919, which overthrew the Kolchak regime in Siberia.

The main office of the road is located at Tomsk, on a branch of the railroad. It seems a peculiar place for the office and the advisability of moving it to Krasnoyarsk on the main line has often been mooted. During the Bolsheviks' short tenure in 1918, the moving of the main office was one

American Car Wheels Stored at Osgulnaya, 40 Miles from Vladivostok

of the things contemplated. The office is located in two or three different buildings, with a multiplicity of employees, something over 2,000. The Russians have a splendid system of records, and to keep up this system requires countless help. They are highly technical in everything, the officials of the roads being graduates of some of the best European technical colleges. There are very few important railway positions in Russia held by anyone except graduates of some technical college.

Tomsk is the seat of learning of Siberia, and is the location of the famous Tomsk University. It is the ambition of all the better class Russians to graduate through this school.

Snow Plough Commonly Used on Russian Railroads

The university has a fine mechanical institute and many engineers graduate there. The city is one of the prettiest in Siberia, being built on the banks of one of the tributaries of the Obi river, which is navigable to the Arctic Ocean.

The Krasnoyarsk Shops

The main shops of the road are located at Krasnoyarsk and are undoubtedly the largest repair shops in Siberia. Krasnoyarsk is an important commercial city with a population of about 100,000 and is built directly on the banks of the great Yenisee river. This immense river, from its source

in Mongolia, winds its way north to the Arctic Ocean. The railway bridge across the river at this point is a magnificent structure, 400 sagenes or 2,800 ft. long, built in six spans. The river is navigable by steamboat to the ocean, but only for a few months in the year.

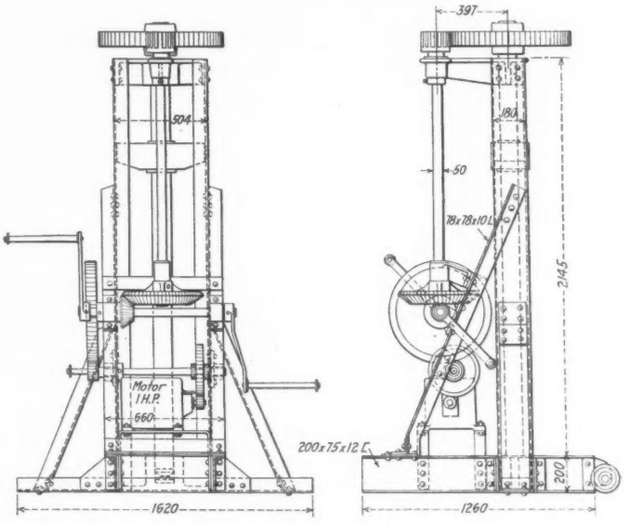
The shops have always been recognized as among the most progressive and efficient in all Russia. During the past years of revolution this plant has been the scene of much turmoil, and one really wonders how it has performed its functions so well. In 1918 the whole roof of the erecting shop was burned, supposedly by the Bolsheviki. Practically deprived of all sources of supply for the past five years, the shops have managed to keep the condition of the power about normal, and when the writer was there in 1919 their statistics showed that engines on the Tomsk railway were really up to their normal standard of peace times. The only engines clogging up the shop were those from European Russia evacuated by the Kolchak government in their retreat before the Bolsheviki.

The superintendent of shops (if he has not been removed by the Bolsheviki) is a clever Russian engineer, Mr. Korkin. A superintendent's position is no sinecure in a large plant in Russia, grievances being in front of him practically all the time. The employees have always had so many special privileges granted them by the government railways that a superintendent must be endowed with exceptional administrative abilities.

The drawing will give some idea of the extent of this plant. The erecting shop is a substantial brick building 464 ft. long and 154 ft. wide, with a high roof. An electrically driven transfer table runs up and down the center of the shop. There are 44 locomotive pits, 22 on each side of the transfer table. Tenders are also repaired in the erecting shop. Locomotives are raised by ingenious electric hoists, which are portable and can be moved to any pit. Four of these hoists are usually required to raise a locomotive, two at each end with structural iron beams across the pit. One of the drawings shows the general design of these hoists. They are operated by a one horse power direct current motor geared at a ratio of about

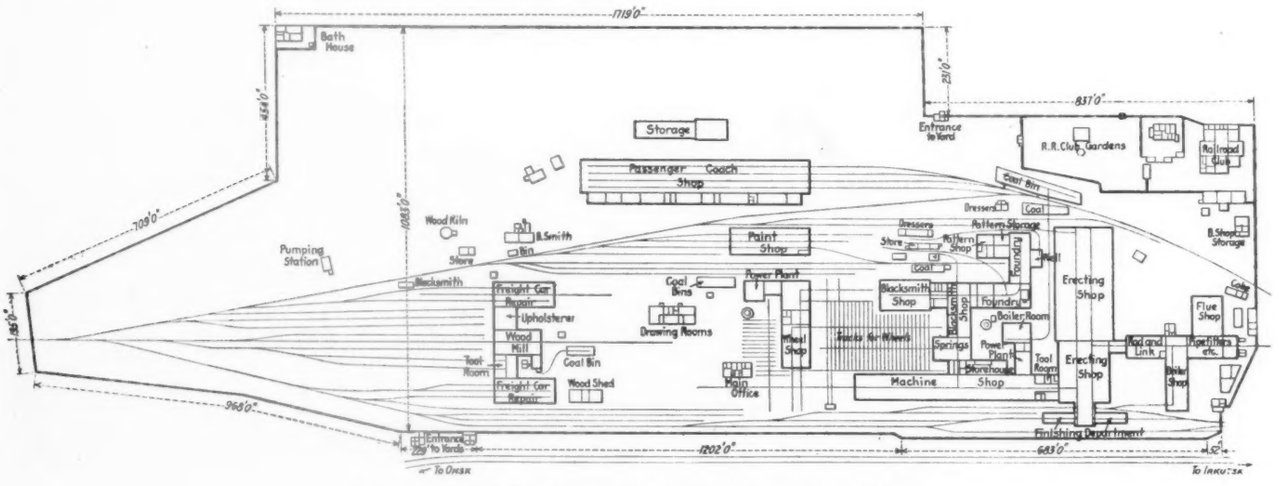
shop without going out of doors, a great advantage in the extremely cold winter weather.

The machine shop, which is located directly off the erecting shop, consists of a long narrow building 528 ft. long and 63 ft. wide. There are a great number of machines in this building, and it is very crowded, but work is taken away as soon as finished, thus relieving matters. The machines are mostly



Locomotive Hoist Used on the Tomsk Railway, Operated by Hand or by Motor

of Russian or German make; there are very few American tools in this part of the world. Two new bolt cutters arrived at the plant in December, 1919, and these were the only American machines. The machines are arranged in groups and driven by electric motors. Since the war the shops have had to make all their small tools, such as taps, dies, reamers



Arrangement of Tracks and Buildings at Krasnoyarsk Shops

20 to 1. All main terminals on the road are also furnished with these hoists, which make heavy repairs considerably easier. A locomotive can be raised high enough to take out wheels in about ten minutes. The shop is served by four 5-ton overhead electric bridge cranes, which are quite suitable for all requirements. At one end of the shop is a building known as the finishing shop, to accommodate two engines. When an engine nears completion it is taken to this shop, fired up and tested before going on its trial trip.

All necessary departments are accessible from the erecting

and drills, and this work keeps many machines busy. Tool steel was also at a premium, and in 1918 and 1919 this shop was forced to use tire steel as a substitute, in order to keep the wheels turning. Crossheads had to be forged here, as no steel castings were available. This was a costly operation, something over 80 hours' machine work being necessary on these forgings.

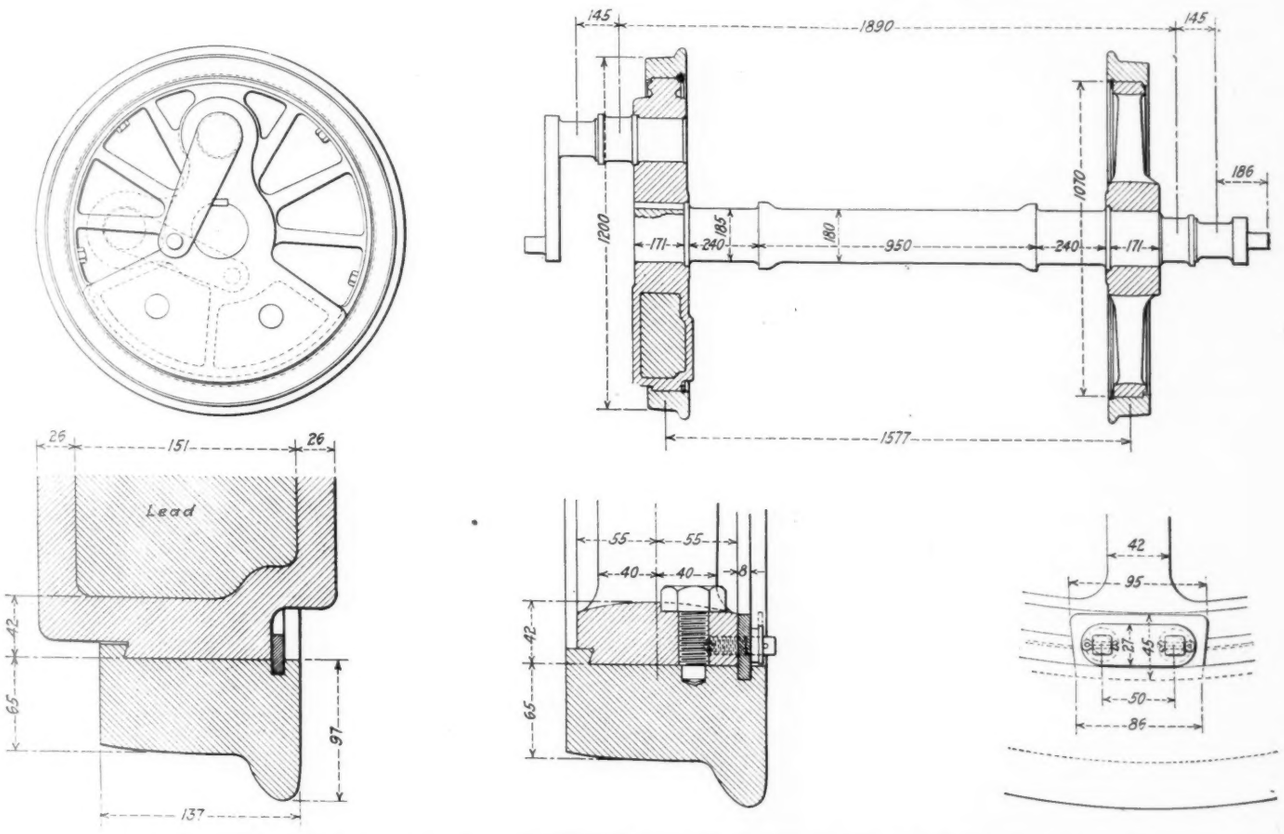
The blacksmith shop is located in two buildings joined to the machine shop. Both are well equipped with steam hammers, but are in great need of forging machines. They have

been forced to make nuts, bolts and rivets, which in pre-war days were bought from the factories, and there is no special machinery for this work.

The foundry, which extends out from the blacksmith shop, consists of two main buildings, one building for small work and one for large work served by a 5-ton overhead electric traveling crane. All the cylinders are cast here and all stock supplies for the road. There is also a brass foundry in connection. The pattern shop is an integral part of the foundry.

East of the erecting shop is located the rod and link department. There is a very fine type of link grinder in this department, a German invention. Rods are very thoroughly and systematically overhauled, although much unnecessary filing and polishing is performed.

The main boiler shop is a building 200 ft. long by 56 ft. wide. It is served by a 30-ton overhead electric bridge crane, which is sufficient for lifting any of the boilers. As the building has a high roof, one boiler can easily be lifted over



Russian Design of Driving Wheels, With One-Piece Pin and Return Crank and Tire Retaining Devices

another. They are equipped with the usual boiler shop machinery, including bending rolls, two radial drills, two lathes and double-ended punch and shears. The main deficiency is lack of air equipment, so that much of the work must be done by hand. The stay bolt drilling is efficiently taken care of by portable electric drills, and these machines can be used in almost any place around the boiler. During the stay of the American engineers, the plant was laid out for air equipment, but the compressor and tools did not arrive before the occupation by the Bolsheviki. There is a great future for air tools in Russia.

The first thing that strikes an American on entering a boiler shop in Russia is the great amount of copper used. All Russian built engines are equipped with copper fire boxes, flue sheets and stay bolts. This entails great expense, but there certainly is very little boiler trouble on the road, leaky flues being quite a rarity. However, very good water is available over nearly the whole Trans-Siberian system.

The flue shop adjoins the boiler shop. The tubes are well taken care of, the tips being welded by power driven rollers, and the flues cut off by a friction saw. The flue rattler is a motor driven cylindrical cast iron drum, similar to many of our older types.

The wheel shop is a neatly arranged building, served with overhead electric traveling cranes. The wheel lathes, which are all Russian built, are strong, powerful machines, equipped with two back and two front compound slide rests. They have been badly handicapped, however, for the past few years for lack of tool steel. The shop has a fine type of quartering machine, specially designed for main pins on Russian locomotives. On the Siberian roads crank arms are all forged solid with the pin, so it is a difficult matter to machine these pins without special tools.

Tires are changed by up-ending the wheel centers, using coal burners for heating. Oil is too precious a thing at this time in Siberia, hence the shops are forced to use coal. Oil was formerly obtained from the south of Russia, but since the revolution this source has been shut off and oil for the road is now obtained through Japanese firms.

The paint shop is a building capable of holding about 20 passenger coaches.

The main car shop is a large building, 606 ft. long by 85 ft. wide, with four tracks running the full length of the building. This gives ample space, so that it is seldom necessary for men to work outside in severe weather. An annex runs along the whole length of this building, in which are located the different departments necessary for coach work. There is a very modern nickel plating room in this building, which takes care of all utensils for dining cars, coach trimmings and other articles.

Two other car shops, each 161 ft. by 63 ft., serve for repairing freight cars. The planing mill is located between these two shops and is equipped with an average amount of wood working machinery.

The shops have their own power plant, which contains two d. c. generators for power and one a. c. machine for lighting. The boiler room is a poor lay out, having a mixture of locomotive type boilers and return tubular boilers. All coal and ashes are handled by hand labor, no mechanical devices being installed. There is another auxiliary plant with six return tubular boilers, used only in winter for heating. All buildings are well heated by large steam radiators.

The general stores are located close to the shops and consist mostly of brick buildings. The stock at the time the American forces were there was much depleted. Before the war there was a standing order that a three years' supply of everything must always be kept on hand, and this foresight was about all that kept them able to run during the days of chaos. During the year 1919 the Allied Technical Board helped them greatly to obtain stock through Vladivostok. In normal times all steel, copper and metal goods came from the Ural mountains, while other supplies came from the interior of Russia. The stores department has a good system of keeping records of stock on hand at all times, but employs lots of help to do this.

Engines are repaired according to a well tabulated schedule, and when a locomotive makes the stipulated verstage, it is tied up and the work done as specified in the railroad's book of rules and repair laws.

In the following table is shown the assigned mileage for shopping engines:

FREIGHT LOCOMOTIVES

30,000 versts	Change of wheels
60,000 versts	Second change of wheels
90,000 versts	Medium repairs
120,000 versts	Third change of wheels
150,000 versts	Fourth change of wheels
180,000 versts	Capital repairs

PASSENGER LOCOMOTIVES

40,000 versts	Change of wheels
80,000 versts	Second change of wheels
120,000 versts	Medium repairs
160,000 versts	Third change of wheels
200,000 versts	Fourth change of wheels
240,000 versts	Capital repairs

The main shops do only the capital or general repairs, and what is known as accidental repairs. Changing of wheels and medium repairs are taken care of at the small shops located at each main terminal. Changing of wheels means the replacement of wheels with worn tires for another set and necessary repairs to driving boxes, machinery and so forth. Each terminal has always on hand a few spare sets of driving wheels and the worn ones are all shipped to Krasnoyarsk shops, where all wheel and axle work is taken care of. The law requires in Russia that all tires must have retaining rings, hence wheel and tire work is quite a large operation. The details of the tire fastenings are shown in the drawing of the wheels and axles.

Some details from the report of work at Krasnoyarsk shops for the years 1916-17-18 and '19 will prove interesting. In 1918 the plant was under Bolshevik control, and a glance at the figures shows that year as the lowest output of the four years, with the greatest number of employees. For example, during January, 1916, there were 1,389 mechanics and laborers employed and the output was equivalent to 7.92 general repairs of four-axle locomotives. In June, 1918, the force had been increased to 2,865, but the output on the same basis was only 1.13 general repairs. The cost of general repairs to locomotives increased 808 per cent from 1916 to 1918. Probably conditions may now be different, as it is a well known fact that the workers became intoxicated with their liberty during the early period of the Bolshevik regime in 1918.

One cannot but admire the quality of workmanship that is put on all repairs. Everything is put together to the closest possible working margin, the matter of expense not being considered. To the mind of the American engineer, too much time is wasted in ornamentation and elaboration; much unnecessary machine and finished work is put on equipment, when the rough article could just as well serve the purpose.

When an engine leaves the shops it must be able to go on the train, make the time, and pull full tonnage on the first trip, or is not accepted by the operating department. This usually necessitates quite a few trial trips before finally leaving the shops, and it is no unusual thing to see the engine raised off the wheels, boxes taken out and refitted between these trips. Diagrams and tests are also made by the mechanical engineers, to be sure that the engine can give the maximum efficiency. The locomotive must be passed as O. K. by trial and inspection before being finally turned over for service.

Taking past conditions into consideration, it is remarkable how well the motive power and rolling stock have been kept up. The next few years will undoubtedly show great changes. The 1,000 pood (16 ton) box cars will likely be replaced by the larger type of American box cars and gondolas. At Vladivostok, American cars were being assembled just as fast as the plant at First river could turn them out, and these cars were getting to be quite numerous on the Trans-Siberian.

Undoubtedly a heavier type of locomotive will also be built in the near future. The roadbed is excellent and bridges are all built with a high enough factor of safety to carry any weight of locomotive we have in America today. The wide gage of five feet is also a good argument in favor of heavier equipment.

There is great opportunity for American ideas and industry in Siberia; now that the embargo has been lifted, let us hope that soon satisfactory trade relations can be established between both countries. The Russian people have a warm feeling for the Americans and have a great craving for American goods.

The writer had 27 months' experience on the Siberian railways and during that period has met many of the leading mechanical engineers on the various systems there. They are all courteous, intelligent and highly trained men. Most of these officials talk either French or German, but it is a rarity to find one who speaks English. If we are to become connected with them commercially, we must study their language. At first it is quite difficult, there is so much difference in the alphabet, but it is absolutely phonetic and can be learned by diligent study. The Russian people have been the victims of circumstances for some years now, but we trust their dark days are nearly over, and that they may soon emerge from their chaotic condition. The rest of the world needs a real Russia; and it is to be hoped that they may not be disappointed.

ACCIDENT BULLETIN 74.—The Interstate Commerce Commission has issued Accident Bulletin No. 74 containing the record of collisions, derailments and other accidents on the railroads of the United States for the last quarter of 1919 and also the tabular statements for the twelve months ending with December. Remarkable decreases are shown in many items, as compared with 1918. In the twelve months of the year now reported, 110 passengers, 366 employees and 41 other persons were killed in train accidents, and 4,549 passengers, 3,202 employees and 124 other persons were injured; as compared with a record in the preceding year of 286 passengers, 554 employees and 156 other persons killed and 4,655 passengers, 4,250 employees and 500 other persons injured.

The Locomotive Terminal an Operating Factor*

Best Use of Terminal Facilities Dependent on Organization, Supervision and Good Management

BY L. G. PLANT
Associate Editor of the Railway Mechanical Engineer

WHILE it would be as impossible to prescribe any fixed mode of terminal operation as to describe equipment that would be universally applicable, there are certain operations in the terminal that are fundamental. Moreover, all terminal operations should proceed with as great regularity and as much expedition as possible.

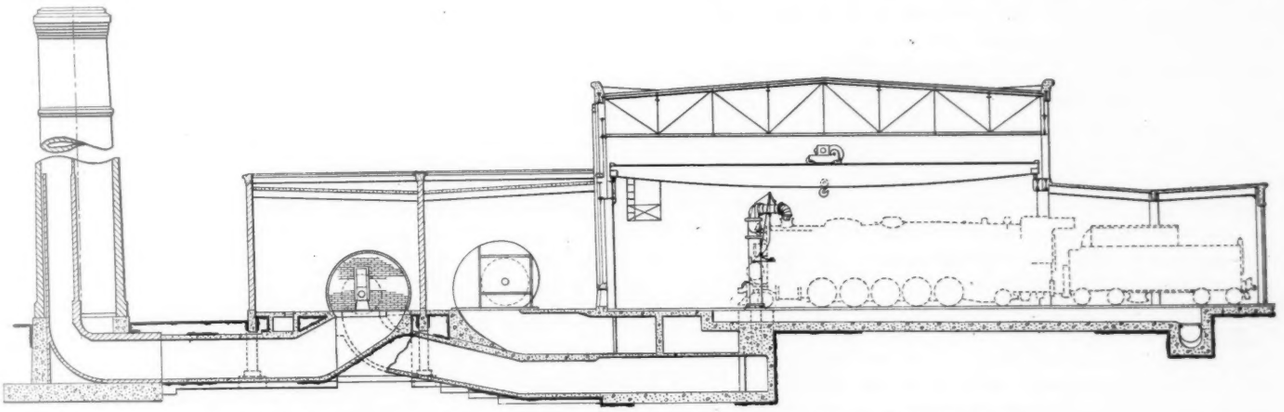
Operation of Locomotive Terminals

Terminal operations constitute an unwritten page on every time table and should be conducted accordingly. The habit of waiting until repairs are actually completed before advising the transportation department that the locomotive is available for service cannot be too strongly condemned. The time at which a locomotive will be available for service should be anticipated as far as possible and the transportation department notified accordingly. It is better to assume responsibility for the unavoidable delay than be the cause of frequent unnecessary delays in dispatching locomotives.

An accurate knowledge of the work required on every locomotive arriving at the terminal is obviously essential to the successful execution of that work, hence thorough locomotive inspection is the only safe foundation upon which terminal operations can proceed successfully. There are very few railroads today on which the work reports submitted by locomotive engineers can be depended upon as a reliable index to the work to be done. Enginemen cannot be relieved of the responsibility for a locomotive condition report and something might be said in favor of educating the engineers to submit a more intelligent report but as matters stand the most careful inspection of arriving locomotives must be made.

More might be said in favor of educating air brake and other inspectors responsible for inspecting locomotives upon arrival at the terminal. Frequent changes in the personnel of the inspection force and appointment on the basis of seniority are bound to result in a certain amount of incompetence in the inspection of locomotives. The railroads will surely be held responsible in the event of accidents resulting from incompetent inspection and if they cannot always pick trained men for this work, should see that instruction of some sort is available to these men. The air brake instruction car should not only be available to every air brake inspector, but these men should be subject to certain examinations that will serve to establish their competence.

Inspection may either be conducted immediately upon arrival or as soon as the locomotive is placed in the house. Where locomotives are arriving at frequent evenly spaced intervals throughout the day, the system of outside inspection in covered pits has very great advantages. The delay over the inspection pit should not average in excess of 15 minutes and a statement of the work required of each gang foreman may be available before the locomotive has actually been placed in the house. Moreover, an advance report in regard to the condition of the locomotive frequently makes it more practical to assemble the necessary material in time so that there is no delay on this account.



Cross Section of Roundhouse with Down Draft Ventilating System and Overhead Crane

Inspection of Locomotives at Terminals

On the other hand, at terminals where comparatively few locomotives are handled or where locomotives arrive at very irregular intervals, it becomes an uneconomical proposition to maintain an outside inspection force. Where an inspection in the enginehouse is promptly made upon the arrival of every locomotive there can be no serious objection to this method. In fact, there is frequently a great advantage to conducting inspection in the enginehouse since it is frequently practical and economical to have inspectors make repairs on certain classes of defects. Locomotive inspection should be subdivided as far as possible. Excellent results are often obtained from assigning one inspector to certain defects that have been causing serious trouble. For instance, it is the practice on one railroad that has made a conspicuous success of Mallet locomotive operation, to assign one mechanic and assistants at each terminal during the winter months to inspect and repair steam leaks exclusively.

One of the most remarkable examples of intensive terminal operation in this country is accomplished by departing boldly from the conventional routine. Approximately 170

*From a paper presented before the New England Railroad Club on November 9, 1920. An abstract of the first part of this paper was published in the December issue of the *Railway Mechanical Engineer*.

locomotives are handled through this terminal each day and as each of these locomotives arrives it is first subjected to the most thorough inspection. There are three parallel inspection pits under the direction of a foreman inspector. The number of men and the facilities at this inspection point are such that many light repairs can be executed during the time that the inspection is being completed. Upon the basis of the reports made by each of the principal inspectors, the foreman decides whether the character of repairs necessitates placing the locomotive in the enginehouse. Where the repairs are not of a heavy nature and do not require the services of a drop pit or crane the locomotive after passing over the ash pit is routed directly to a longitudinal repair shed. This shed covers two parallel track pits approximately 400 ft. in length. The building is of concrete and steel sash construction and the illumination, both overhead and in the pits, is very complete. The work at this repair shed is under the direction of an assistant roundhouse foreman and the number of mechanics employed is equal to any emergency. Moreover, the stores department have erected special facilities to provide for the material requirements at this point. While the work in this light running repair shed is conducted with the same degree of system and thoroughness as should characterize roundhouse work, it will readily be appreciated that these repairs can be executed far more expeditiously under the circumstances than were it necessary to place each locomotive in the enginehouse. In fact, it would be practically out of the question to handle 170 locomotives in and out of a 30 stall roundhouse each day and the general plan adopted at this point is one that might well be put into effect at other points where fewer locomotives are handled.

Locomotive Terminal Organization

Any consideration of the locomotive terminal as an operating factor must take into account the organization of the terminal. This is just as essential in the make-up of the terminal as the physical equipment. In fact the usefulness of this equipment depends wholly upon the extent to which its potential possibilities are developed. The most elaborate terminal equipment will be of little value to the railroad if we do not have men who know how these facilities can be used to the best advantage and who are on the ground to see that the equipment is so used. Nowhere on the railroad will the lack of organization show up more quickly than at the locomotive terminal.

Supervision is an essential element in organization; we must not only have men who can execute repairs promptly and handle locomotives expeditiously but we must have men whose duty it is to see that these things are done. In this connection we must clearly differentiate between mere system and organization. What I wish to infer is that organization in this case is more than a question of the number of supervisory officers, their titles or relative positions. It is entirely possible to have too many supervisors as well as too few, to reach a point where the organization becomes top heavy and each man becomes a cog in the wheel rather than an individual unit. It is particularly essential in terminal operation that individual initiative be fostered and that each foreman's authority and responsibility be as broad as possible.

The roundhouse foreman's position is not an office job and unless he is a live wire who is on the job every minute of the day and has the entire situation constantly at his finger tips, we cannot expect 100 per cent service no matter how elaborate the equipment. In this fact lies the only explanation I can offer for the phenomenon which we have all witnessed wherein the results obtained in a poorly equipped enginehouse with some boomer foreman are found to surpass the performance of a far better equipped terminal operating under the direction of a far more elaborate complement of supervisors.

The problem of getting and holding the type of men most needed for terminal operation is a serious one. When the railroad is fortunate in finding such men it must deal wisely and liberally with them. The proper course would be to develop material from within the ranks and it is not improbable that within a short time the railroads will see the wisdom of establishing central schools in which prospective foremen can be taught the rudiments of foremanship and be carefully examined in regard to all the details with which they should be familiar.

Locomotive Terminal Management

The problem of terminal management is very closely identified with that of organization because the strength of the organization depends greatly upon the character of the management. Constructive management can often develop excellent foremen out of the most unpromising material. On the other hand poor management which may be characterized by the lack of any broad fixed policy with respect to terminal operation or organization or failure to set any standard of achievement to which terminal forces may aspire, may deprive the railroad of some of its best talent.

It should be the policy of every railroad to establish a positive standard for every terminal and it is the duty of the mechanical officers who are responsible for terminal performance to see that these standards are lived up to. There are very few men who will not do better work and more work when it is known that this work will be subject to the most detailed scrutiny by superior officers. No matter how competent the foreman, the operation of any terminal can be improved by keeping a close check upon its performance. It is in this connection that the full value of statistical control must be appreciated. While there are no statistics which can be relied upon to take the place of a first hand knowledge relating to the condition of motive power from a maintenance standpoint, there is no question but that the operation of the average terminal can be accelerated by means of a daily operating report, without in any way impairing maintenance. In many instances a close check on the performance of the terminal has resulted in speeding up the movement of locomotives across the ash pit which is a clear gain so far as it concerns the time available for necessary maintenance.

The Value of Terminal Statistics

The efficacy of various reports dealing with the movements of locomotives at the terminals as a practical means for improving terminal operation has been questioned. Mechanical department officers who are critically inclined should bear in mind that the results of such reports not only indicate enginehouse detention but all terminal delays including those that are wholly chargeable to the transportation department It cannot be denied, moreover, that statistics of this character have served to focus attention on terminal movements and bring about improvements that might otherwise have been overlooked. Records relating to terminal movements have become very useful to progressive mechanical officers in demonstrating the relative efficiency of various features of terminal equipment. They have made it possible for a mechanical superintendent to estimate with reasonable accuracy the return that can be expected from an investment in a new ash pit or a boiler washing outfit. Statistics have served to demonstrate the extent to which use is made of the facilities available. With the assurance that existing facilities are being utilized to the utmost limit, executives have been encouraged to spend money towards improving these facilities.

There is undoubtedly a growing appreciation of the fact that the locomotive terminal is in reality an operating factor, that a block in the terminal may mean a block on the main line and that co-operation between the mechanical and operating departments must be the keynote to terminal management. Mechanical officials must realize that in their connection with the movement of locomotives through the terminal they are operating men in every sense of the word. Also operating officials should appreciate the fact that the locomo-

tive terminal is not purely a mechanical facility identified with locomotive maintenance but a very important link in their main line.

Terminal Development Policies

In conclusion something should be said in regard to the policies that should be adopted toward locomotive terminal development. Being firmly convinced of the importance of the locomotive terminal as an operating as well as a maintenance factor on the railroads, it would appear to be the duty of every mechanical officer responsible for the performance of locomotive power to urge upon his superior officers the necessity for adequate terminal development.

It should be the policy of the railroads to maintain a proper relationship between locomotive and locomotive terminal development based on the safe assumption that the full value of a modern locomotive can never be realized in an antiquated terminal. One railroad might be cited as having made a conspicuous success of Mallet locomotive operation over long operating divisions because their terminal facilities were equal to the burden and because their terminal organization was trained to the task. On another railroad the absolute failure of well-designed Mallet locomotives can be ascribed largely to inadequate terminal facilities and lack of terminal organization.

If the problem were always as plainly understood it would not be so difficult to develop a proper policy. As it is, terminal development calls for foresight and the most discriminating judgment. Every expenditure for terminal improvement should conform to a broad comprehensive plan embracing ultimate terminal development so far as this can be forecast. The erection of an expensive concrete coaling station at some point where other facilities are inadequate and where terminal development along other lines must always be limited illustrates a pitiful lack of foresight. While the locomotive terminal cannot be regarded as a suitable dumping place for worn out machine tools from larger shops, there can be little excuse for going to the other extreme and buying a wheel lathe for terminal use that will turn a pair of tires in 45 minutes when the maximum requirement at that terminal will seldom exceed one set of tires per week. Undoubtedly many projects for locomotive terminal development are discredited by just such lack of foresight or failure on the part of mechanical officers to comprehend the purely business viewpoint that in the last analysis must dictate every good move in the conduct of our railroads.

Looking into the future, it is reasonable to predict that terminal development will undergo greater relative development than any other phase of transportation. It is of the utmost importance to mechanical officers that they not only have the foresight to realize the extent to which terminal equipment must be rehabilitated and the organization strengthened but the courage to command a program that will make the locomotive terminal a successful operating factor.

Boards of Adjustment to Be Abolished

John Barton Payne, director general of railroads, has issued a circular announcing the abolition of the boards of adjustment created by the Railroad Administration as follows:

"A committee representing the Association of Railroad Executives has brought to my attention the fact that General Orders 13, 29 and 53 provide in terms that,

'Personal grievances and controversies arising under interpretation of wage agreements and all other disputes arising between officials of a railroad and its employees covered by this understanding will be handled in their usual manner by joint committees of the employees up to and including the chief operating officer of the railroad (or some one officially designated by him). If an agreement is not reached, the chairman of the joint committee of employees refers the matter to the chief executive officer of the organization concerned. If the contention of the employees' committee is approved by such executive officer, then the chief operating officer of the railroad and the chief executive officer of the organization concerned shall refer the matter with all supporting papers to the director of the Division of Labor of the U. S. Railroad Administration, who will in turn present the case to the Railway Board of Adjustment, which board would promptly hear and decide the case, giving due notice to the chief operating officer of the railroad interested and to the chief executive officer of the organization concerned of the time set for the hearing.'

"That after the order of May 29, 1920, and amendment under which the time limit of July 15 was fixed within which claims growing out of the subject matter of said orders should be presented the claimants, without complying with the procedure specified in said general orders, presented their claims direct to the office of the director general and, in view of this fact, none of the said claims are now properly before said adjustment boards.

"I have given careful consideration to each contention and am advised that if said contention is sustained, practically all of the cases now pending before Boards of Adjustment 1, 2 and 3 will fall and must fail of consideration.

"The point made by the representatives of the executives appears to me to be sound and there is nothing contained in the limitation order of May 29, 1920, changing the mode of procedure. But as I look upon the matter the railroads as such are not concerned in the pending claims, if the claims are limited, as in my judgment they must be limited, to the period of federal control. That is, it is for the director general to determine and to pass upon claims against the government by persons who were the employees of the government during the period of federal control and to provide for the payment of all just claims arising during federal control, just as he must pass upon and provide for the payment of all other claims arising from federal control.

"If, however, the decision of these claims is to affect the railroads after the end of federal control, then the railroads have the right to insist upon a strict compliance with the terms of the said general orders.

"I am further advised that Board No. 1 will be able to dispose of all leases pending before it by February 15, that the number of cases pending before Boards 2 and 3 are so large that many months must elapse before said Boards could dispose of them.

"My conclusion, therefore, is that as to cases pending before Boards 2 and 3 some other means must be found to deal justly by the claimants as to any money due them arising out of federal control.

"The application of all decisions hereafter made to be limited in their effect to money due claimants between January 1, 1918, and March 1, 1920.

"It is, therefore, ordered that Board No. 1 be abolished as of February 15, 1921; that Board No. 2 and Board No. 3 be abolished as of January 10, 1921; i. e., by 30 days' notice, as provided in said General Orders.

"Meantime, means will be provided to adequately, justly and promptly dispose of all claims which said boards may leave undisposed of."

The views of railroad officials and representatives of organized railroad employees are widely at variance as to the desirability of establishing national boards.

The directors of the Chamber of Commerce of the United States recently adopted a resolution opposing the creation of national boards of adjustment as not in the public interest. The preamble states that the public interest is involved in that no provision is made for public representation on the proposed boards. The resolution goes on to state that the establishment of the boards would tend to bring about a state of nationalization of the railroads, that they would lessen efficiency and impair the discipline necessary to successful operation of the railways. Furthermore, they would prevent open shop operation on the railroads and this would inevitably be extended to other industries.

Report of the Bureau of Locomotive Inspection

Application of Water Columns and Other Devices Advocated; Accidents Increase in Fiscal Year 1920

THE outstanding feature of the report of the chief inspector of locomotive boilers to the Interstate Commerce Commission for the fiscal year ending June 30, 1920, is the increase in the number of accidents and casualties resulting from failures of parts of locomotives and tenders. Although the percentage of locomotives inspected which were found defective decreased from 58 per cent in 1919 to 52 per cent in 1920, the number of accidents increased 49 per cent, the number killed 15 per cent and the number injured 41 per cent. A summary of the chief inspector's report is given below.

The succeeding tables and charts have been arranged so as to permit comparison with previous reports, as far as consistent, and show in concrete form the number of locomotives inspected, the number and percentage of those inspected found defective, and the number ordered out of service because of not meeting the requirements of the law, together with the total number of defects found. They also show the total number of accidents caused by failure from any cause of the locomotive or tender, including the boiler, and all parts and appurtenances thereof, reported by the carriers, or discovered by inspectors, together with the number of persons killed or injured due to such failure.

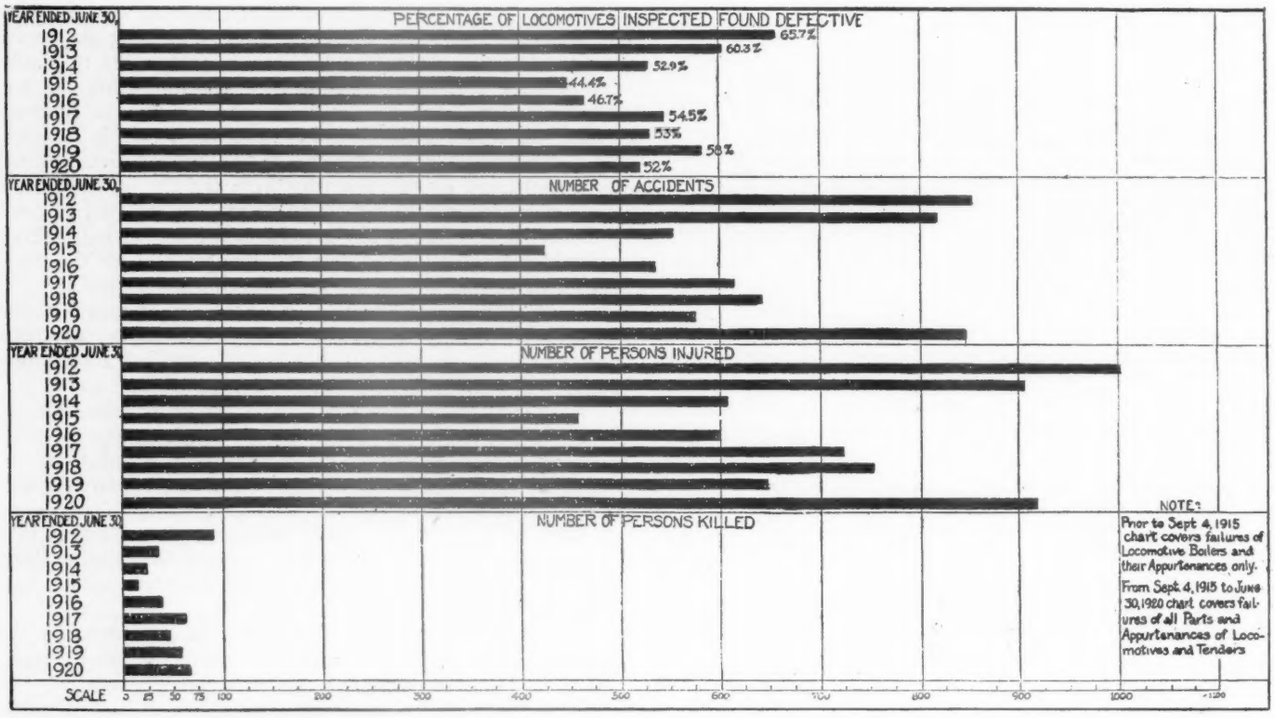
NUMBER OF ACCIDENTS, NUMBER KILLED, AND NUMBER INJURED, REPORTED, AND INVESTIGATED, COVERING FAILURES OF ALL PARTS AND APPURTENANCES OF THE ENTIRE LOCOMOTIVE AND TENDER BY COMPARISON

	1920	1919	1918	1917
Number of accidents	843	565	641	616
Decrease from previous year	[1]49.2	[1]11.8	[1]4.1	....
Number killed	66	57	46	62
Decrease from previous year	[1]15.8	[1]23.9	25.8	....
Number injured	916	647	756	721
Decrease from previous year	[1]41.6	14.4	[1]4.8	....

[1]Increase.

The following table shows the number of accidents, number of persons killed, and number injured, due to the failure of some part or appurtenance of the locomotive boiler only, which were reported by the carriers, with their percentage of decreases by comparison of the fiscal years ended June 30, 1912 and 1913, with the fiscal years ended June 30, 1919 and 1920:

	1920	1919	1913	1912
Number of accidents	439	341	820	856
Increase 1920 over 1919	28.8	....	....	....
Decrease 1920 from 1912	48.7	....	....	....
Number killed	48	45	36	91
Increase 1920 over 1919	6.7	....	....	....
Decrease 1920 from 1912	47.2	....	....	....
Number injured	503	413	911	1,005
Increase 1920 over 1919	21.8	....	....	....
Decrease 1920 from 1912	49.9	....	....	....


YEAR ENDED JUNE 30,
PERCENTAGE OF LOCOMOTIVES INSPECTED FOUND DEFECTIVE
1912 65.7%
1913 60.3%
1914 52.9%
1915 44.4%
1916 46.7%
1917 54.5%
1918 53%
1919 58%
1920 52%
NUMBER OF ACCIDENTS
NUMBER OF PERSONS INJURED
NUMBER OF PERSONS KILLED
NOTE:
Prior to Sept. 4, 1915 chart covers failures of Locomotive Boilers and their Appurtenances only.
From Sept. 4, 1915 to June 30, 1920 chart covers failures of all Parts and Appurtenances of Locomotives and Tenders
SCALE
0 25 50 75 100 200 300 400 500 600 700 800 900 1000

Graphic Summary of Results of Inspection and Accidents Due to Locomotive Failures, 1912-1920

LOCOMOTIVES INSPECTED, NUMBER FOUND DEFECTIVE, PERCENTAGE INSPECTED FOUND DEFECTIVE, NUMBER ORDERED OUT OF SERVICE, AND TOTAL DEFECTS FOUND BY COMPARISON

	1920	1919	1918	1917
Number of locomotives inspected	49,471	59,772	41,611	47,542
Number found defective	25,529	34,557	22,196	25,909
Percentage found defective	52	58	53	54.5
Number ordered from service	3,774	4,433	2,125	3,294
Total defects found	95,066	135,300	78,277	84,883

NUMBER OF DERAILMENTS DUE TO DEFECTS IN OR FAILURE OF PARTS OF THE LOCOMOTIVE OR TENDER, REPORTED TO AND INVESTIGATED BY THIS BUREAU, AND NUMBER OF PERSONS KILLED AND INJURED AS A RESULT, BY COMPARISON

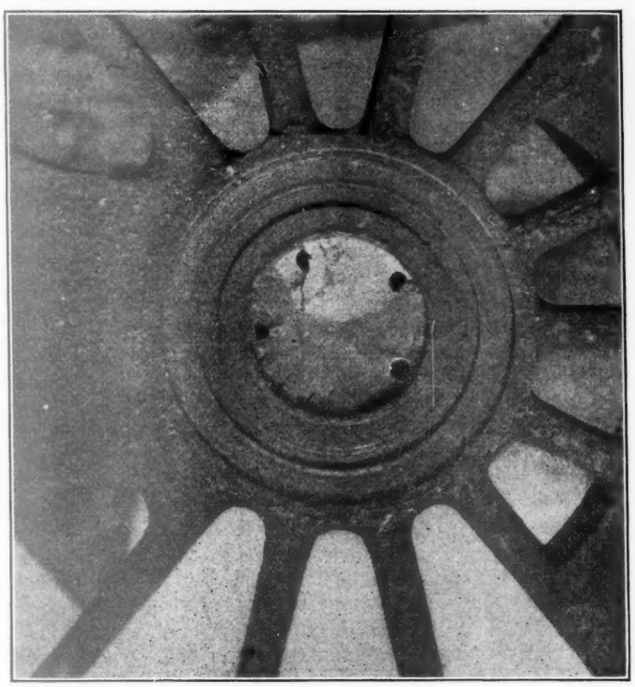
	1920	1919	1918	1917
Number of derailments[1]	7	7	2	4
Number killed	7	6	..	1
Number injured	18	7	2	21

[1]Only derailments, reported as being caused by defects in or failure of parts of the locomotive or tender have been investigated by this bureau.

The following table shows the total number of persons killed and injured by failure of locomotives or tenders, or some part or appurtenance thereof, during the four years ended June 30, 1917-1920, classified according to occupations.

	1920		1919		1918		1917	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of the train crew:								
Engineers	16	272	14	194	11	245	16	230
Firemen	20	404	22	265	19	306	21	304
Brakemen	9	77	11	82	6	62	13	60
Conductors	2	19	2	16	..	21	3	14
Switchmen	4	19	1	7	2	..	..	8
Roundhouse and shop employees:								
Boiler makers	2	9	1	9	..	11	..	11
Machinists	1	20	..	5	..	11	..	8
Foremen	..	3	..	3	1	4	..	1
Inspectors	..	1	..	6	4	4	..	3
Watchmen	4	3	..	2	..	3	..	5
Boiler washers	..	13	..	7	1	4	..	7
Hostlers	..	13	..	6	..	8	..	6
Other roundhouse and shop employees	3	30	1	11	2	19	2	19
Other employees	4	26	3	23	..	26	5	22
Nonemployees	1	7	2	11	..	24	1	23
Total	66	916	57	647	45	756	62	721

A summary of all accidents and casualties occurring during the fiscal year ended June 30, 1920, as compared with

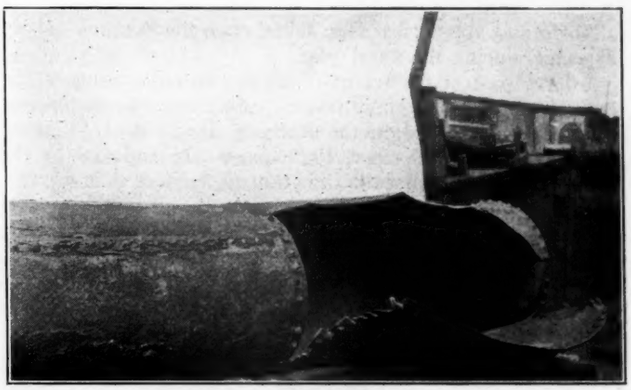


Failure of Driving Axle Caused by Fracture Starting at Bottom of Holes Drilled for Plugs Used in Attempt to Tighten Wheel Fit

the year ended June 30, 1919, covering the entire locomotive and tender and all of their parts and appurtenances, shows an increase of 49 per cent in the number of accidents, an increase of 16 per cent in the number killed, and an increase of 42 per cent in the number injured. This increase is due almost wholly to disregard for the requirements of the law and rules as well as to safety of construction and operation. This is especially true with what are sometimes considered unimportant parts; for instance, 26 per cent of the increase in accidents and injuries was due to failure of grate shakers; 10 per cent was due to failure of reversing gear; and 10 per cent to failure of squirt hose.

A summary of all accidents and casualties caused by failure of the boiler and its appurtenances only, for the fiscal year ended June 30, 1912 (the first year of the existence of the law), as compared with the year ended June 30, 1920, shows a decrease of 47 per cent in the number of accidents, a decrease of 48 per cent in the number killed, and a decrease of 49 per cent in the number injured. These decreases are especially gratifying when considering the increased number of locomotives in service and the increased traffic being handled, together with the increased duties imposed on the inspectors by the amendment to the boiler-inspection law, which extended their duties to the entire locomotive and tender and the parts and appurtenances thereof, which has added greatly to their work. These decreases demonstrate the wisdom of complying with the requirements of the law and rules, and the wisdom and foresight of its advocates when requesting its enactment.

As shown by the table, derailments due to defects in or failure of parts of the locomotive or tender have been the



Corroded Main Air Reservoir Which Exploded, Causing the Death of One Person

direct cause of a number of most serious accidents and the loss of life and limb as well as damaged property and have forcibly demonstrated the necessity for proper inspection and repair of the running gear, driving gear, and brake rigging.

During the year the inspectors of this bureau were called upon by the commission to perform various duties not in connection with their regular work, which materially reduced the number of locomotives shown inspected by them, as well as the number ordered out of service, and it appears that certain railroad officials and employees have taken advantage of their temporary absence and permitted locomotives to remain in service with serious defects, which would have been known to them had proper inspections been made and reports rendered as required.

It was found necessary to ask the courts to inflict the penalty provided in section 9 of the law, because of the defective condition in which locomotives were being operated by one carrier and its willful violation of the requirements of the law and rules. This case is now pending and is set for the October term of the court. It is evident that unless an immediate improvement is made by certain other carriers it will be necessary to file similar suits in the near future. That the law places the burden of proper inspection and repair and compliance with the rules of inspection on the carriers owning or operating the locomotives seems to have been lost sight of, and this is reflected in the increased number of accidents and casualties during the year.

Referring to failures of seams in boilers welded by the autogenous process, the recommendation made in the last annual report that such methods should not be applied to any part of the boiler where the strain is not carried by other construction nor in the low water zone of the firebox, is repeated, with the further recommendation that this should apply to all parts of the locomotive and tender subject to severe stresses and shocks where failures might cause accidents. During the year, 258 applications were filed for

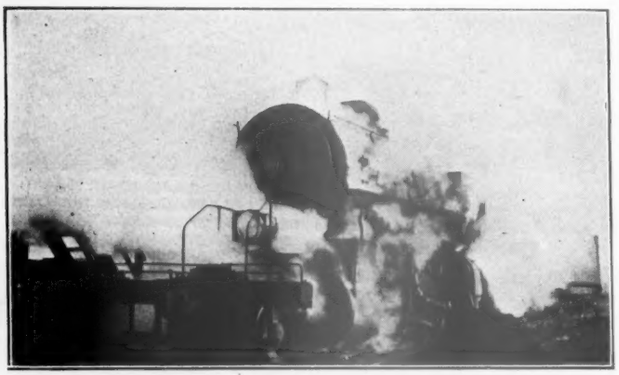
extension of time for the removal of flues, as provided in rule 10. Investigation showed that in 31 of these cases, the condition of the locomotives was such that no extension could properly be granted. Twenty-five were in such condition that the full extension requested could not be granted, but an extension for a shorter period within the limits of safety was allowed. Ten extensions were granted after defects disclosed by our investigation had been repaired. Thirty-seven applications were withdrawn for various reasons and the remaining 155 were granted for the full period requested.

During the year, close attention was given to the equipping of locomotives with headlights that would meet the requirements of the commission's orders of December 26, 1916, and December 17, 1917, and reports indicate that on July 1 practically all locomotives in service were equipped in accordance therewith.

No formal appeal has been taken from the decision of any inspector, during the fiscal year.

A large part of the report is devoted to an account of the tests of water indicating devices conducted by the bureau which were described in the *Railway Mechanical Engineer* for September and October, 1920, pages 575 and 630.

The chief inspector calls attention to the fact that services



A Locomotive That Is Not Only Unsafe But Also Uneconomical

of the inspectors were required in making various investigations during the year and, in view of this fact, recommends that the act of February 17, 1911, be amended so as to provide for additional inspectors, to be appointed by the commission, upon the recommendation of the chief inspector, as the needs of the service develop. Other recommendations that are repeated are as follows:

That all locomotives not using oil for fuel have a mechanically operated fire door, so constructed that it may be operated by pressure of the foot on a pedal or other suitable device.

That all locomotives be provided with a bell so arranged and maintained that it may be operated from the engineer's cab by hand and by power.

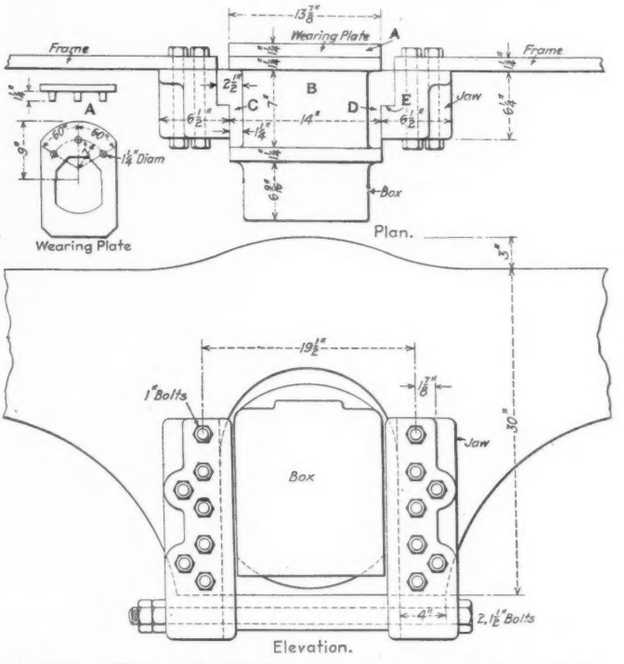
That cabs of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, have a suitable stirrup or other step, and a horizontal handhold on each side, approximately the full length of the cab, which will enable the enginemen to go from the cab to the running board in front of it; handholds and steps or stirrups to be securely fastened with bolts or rivets; the distance between the step and handhold to be not less than 60 inches nor more than 72 inches.

That all locomotives where there is a different indication between the gage cock and water glass of two or more inches of the water level under any conditions of service be equipped with a suitable water column to which shall be attached three gage cocks and one water glass with not less than 6 in., preferably 8 in., clear reading, and one additional water glass with not less than 6 in., preferably 8 in., clear reading, located on the left side or back head of the boiler. The water glasses to be so located, constructed, and maintained that they will register the approximate general water level in the boiler under all conditions of service and show a corresponding level within 1 inch and be so located, constructed, and maintained that the engineer and fireman may under all conditions of service have an easy and clear view of the water in the glass from their respective and proper positions in the cab. The gage cocks to be so located that they will be in easy reach of the engineer from his proper position in the cab.

The usual chart showing the number of accidents occurring during the fiscal year from 1912 to 1920 due to failure of various parts of a locomotive, is shown, and this information is also given in tabular form. Another section of the report lists the accidents occurring on each railroad under the jurisdiction of the bureau, with a summary in tables which show also the number of locomotives inspected and the numbers found defective and ordered from service. A supplement at the conclusion of the report shows typical examples of defective conditions and accidents resulting from defects with a short account of the causes of the failure.

Trailer Box With Lateral Adjustment

The Ann Arbor railroad has equipped its Atlantic type locomotives with a trailer box and pedestal that permits the application of the lateral plate without dropping the wheels and also makes possible the taking up of lateral play until the



A Unique Type of Trailer Box Pedestal Designed to Facilitate Repairs

plate is entirely worn out. The arrangement is illustrated in elevation and plan in the drawing shown herewith.

In this design, the jaws are set far enough apart to permit the withdrawal of the box *B* as keys *C* and *D* are raised vertically out of place. This permits the application of a wearing plate *A* after which the box is replaced in position and the keys *C* and *D* dropped into their places. In order to use up the wearing plate completely and at the same time keep the lateral motion within the prescribed limits, keys of bar iron may be inserted at the shoulder marked *E*. After the plate is completely worn out by the application of these filling blocks, a new wearing plate may be applied. This arrangement, which was originated by J. E. Osmer, superintendent of motive power of the Ann Arbor, has been very successful in service.

Federated American Engineering Societies' Meeting

Herbert Hoover Speaks on Some Phases of Relationship of Engineering Societies to Public Service

THE first meeting of the Federated American Engineering Societies as an independent organization was held at the New Willard Hotel, Washington, D. C., on November 18, 19 and 20. Herbert Hoover was unanimously elected president of the American Engineering Council, and thus becomes the active head of this organization. Twenty-one member societies and nine societies which have not yet taken final action, participated in the meeting.

The executive board of thirty members was elected in part. As there were a number of societies which were expected to join shortly, four vacancies were left on the board in order that these societies might later be given proper representation. According to the societies' constitution, the country was divided into six districts as follows:

District 1—New England and New York.
District 2—Michigan, Wisconsin and Minnesota.
District 3—Ohio, Indiana and Illinois.
District 4—New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia.
District 5—All the southern states, including Louisiana and Texas, and
District 6—All other states west of the Mississippi river.

Of the national societies, the American Society of Mechanical Engineers received 4 places; the American Institute of Mining and Metallurgical Engineers, 3; the American Institute of Electrical Engineers, 4; the American Institute of Chemical Engineers, 1; the American Society of Agricultural Engineers, 1; and the Society of Industrial Engineers, 1. The executive officers elected are Herbert Hoover, Palo Alto, Cal., president; Calvert Townley, New York, vice-president; W. E. Rolfe, St. Louis, Mo., vice-president; D. S. Kimball, Ithaca, N. Y., vice-president; J. Parke Channing, New York, vice-president; and L. W. Wallace, Baltimore, Md., treasurer. Members of the executive board were elected to represent the organizations mentioned above and also some of the local districts.

No permanent location for headquarters was chosen, although the majority felt that in order to carry on the work of public service for which the federation was organized, it would be necessary to maintain an office in Washington. It was decided that the headquarters be located in that city after January 1, 1921, and until that time the society would carry on its work in the Washington office of the Engineering Council through the courtesy of that organization.

The Committee on Plan and Scope presented a large number of topics of interest to the public at large which would give the society an opportunity for constructive work. The more important of these included the conservation of labor or the reduction of economic waste, transportation, the establishment of a department of public works, national fire protection, patents, licensing of engineers, education, compensation, service bureau and numerous others, some of which are now in the hands of the Engineering Council.

Of the public service work to be undertaken, the reduction of economic waste will probably receive first consideration. Mr. Hoover emphasized this strongly in an address on "Some Phases of Relationship of Engineering Societies to Public Service." An abstract of the address follows:

Address of Herbert Hoover

The greatest of the problems now before the country and, in fact, before the world, are those growing out of our industrial development. The enormous industrial expansion of the last 50 years has lifted the standard of living and comfort beyond any dream of our forefathers.

We have built up our civilization, both political, social and economic, on the foundation of individualism. We have found in the course of development of large industry upon this system that individual initiative can be destroyed by allowing the concentration of industry and service, and thus an economic domination of groups over the whole. While our present system of individualism under controlled capitalism may not be perfect, the alternative offers nothing that warrants its abandonment. Our thought, therefore, needs to be directed to the improvement of this structure and not to its destruction.

A profound development of our economic system apart from control of capital and service during the last score of years has been the great growth and consolidation of voluntary local and national associations. These associations represent great economic groups of common purpose, and are quite apart from the great voluntary groups created solely for public service. This engineers' association stands somewhat apart among these economic groups in that it has no special economic interest for its members. Its only interest in the creation of a great national association is public service, to give voice to the thought of the engineers in these questions. And if the engineers, with their training in quantitative thought, with their intimate experience in industrial life, can be of service in bringing about co-operation between these great economic groups of special interests, they will have performed an extraordinary service.

Relations Between Employer and Employee

We have just passed through a period of unparalleled speculation, extravagance and waste. We shall now not only reap its inevitable harvest of unemployment and readjustment, but we shall feel the real effect of four years of world destruction, and from it economic and social problems will stand out in vivid disputation. One of the greatest conflicts rumbling up in the distance is that between the employer on one side and organized labor on the other. There are certain areas of conflict of interest, but there is between these groups a far greater area of common interest, and if we can find measures by which, through co-operation, the field of common interest could be organized, then the area of conflict could be in the largest degree eliminated.

The American Federation of Labor has publicly stated that it desires the support of the engineering skill of the United States in the development of methods for increasing production, and I believe it is the duty of our body to undertake a constructive consideration of these problems and to give assistance not only to the Federation of Labor but also to the other great economic organizations interested in this problem, such as the Employers' Association and the chambers of commerce.

The Three Great Wastes in Production

It is primary to mention the three great wastes in production; first, from intermittent employment; second, from unemployment that arises in shifting of industrial currents, and third from strikes and lockouts. Beyond this elimination of waste there is another field of progress in the adoption of measures for positive increase in production.

In the elimination of the great waste and misery in intermittent employment and unemployment, we need at once co-ordination in economic groups. For example, in the bituminous coal industry where the bad economic functioning of that industry results in an average of but 180 days' employ-

ment per annum, a great measure of solution could be had if a basis of co-operation could be found between the coal operators, the coal miners, the railways and the great consumers. The combined result would be a higher standard of living to the employees, a reduced risk to the operator, a fundamental expansion of economic life by cheaper fuel. With our necessary legislation against combination and the lack of any organizing force to bring about this co-operation, the industry is helpless unless we can develop some method of governmental interest, not in governmental ownership, but in stimulation of co-operation in better organization. In the great field of seasonal and other unemployment, we indeed need an expansion and better organization of our local and federal labor exchanges. The individual worker is helpless to find the contacts necessary to make this seasonal shift unless the machinery for this purpose is provided for him.

In the questions of industrial conflict resulting in lockouts and strikes, one mitigating measure has been agreed upon in principle by all sections of the community. This is collective bargaining, by which, whenever possible, the parties should settle their difficulties before they start a fight. The point where the universal application of collective bargaining has broken down is in the method of its execution. The conflict arises almost wholly over the question of representation and questions of enforcement. The second Industrial Conference proposed a solution to this point by the provision that where there was a conflict over representation the determination should be left to a third and independent party. It also proposed that each party should have the right to summon skill and experience to its assistance. It further proposed that where one of the parties at dispute refuses to enter upon collective bargaining, the entire question should be referred to an independent tribunal for investigation as to the right and wrong of the whole dispute—but only for investigation and report.

Hours of Labor

There are questions in connection with this entire problem of employer and employee relationship, both in its aspects of increased production and in its aspects of wasteful unemployment, that deserve most careful study by our engineers. There lies at the heart of all these questions the great human conception that this is a community working for the benefit of its human members, not for the benefit of its machines or to aggrandize individuals; that if we would build up character and abilities and standard of living in our people, we must have regard to their leisure for citizenship, for recreation and for family life. These considerations, together with protection against strain, must be the fundamentals of determinations of hours of labor. These factors being first protected, the maximum production of the country should become the dominating purpose.

The precise hours of labor should and will vary with the varying conditions of trades and establishments, but the proper determination of hours, based upon these factors, is an immediate field demanding attention of engineers. There is no greater economic fallacy than the doctrine that the decrease of hours below these primary considerations makes for employment of great numbers, and it is an equal certainty that the 84-hour week of some employments transgresses these fundamentals to a point of inhumanity.

Incentive and Increased Production

There is a broad question bearing upon stimulation of self-interest and thus increase in production that revolves around the method of wage payment. I need not review to you the advantages, difficulties and weaknesses of bonus, piece work, profit or saving sharing plans that are in use as a remedy for the deadening results of the same wage payment to good and bad skill alike. A suggestion for your consideration is the possible use of another device in encouragement of individual interest and effort by creating two or three levels of wage in agreements for each trade, the position of each man in such scale to be based upon comparative skill and character. This plan should be developed upon the principle of graded extra compensation, for added skill and performance, above an agreed basic wage. In order to give confidence, the classification under such scales must be passed upon by representatives of the workers in such shop or department. This plan is now being successfully experimented with.

We must take account of the tendencies of our present repetitive industries to eliminate the creative instinct in its workers, to narrow their field of craftmanship, and to discard entirely the contribution to industry that could be had from their minds as well as from their hands. There has been a great increase in shop committees as a method to relieve this tendency. Where they have been elected by free and secret ballot among the workers, where they are dominated by a genuine desire on both sides for mutual co-operation in the shop, they have resulted in great good. Organized labor has opposed some forms of these committees because of the fear that they may break down trade organization covering the area of many different shops.

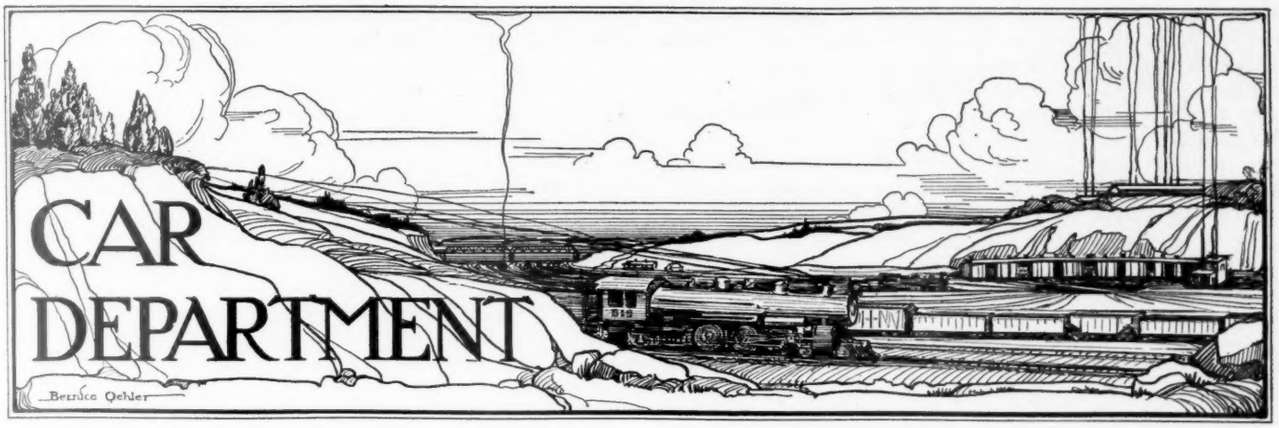
Co-operation with Labor Organizations

Again I believe the engineers could assist in the erection of a bridge of co-operation if organized labor, which has already made a beginning, would extend more widely its adoption of the principles of a shop committee settling its problems of wage and conditions of labor in general agreement and applying its energies through shop committee organization to development of production as well as to the correction of incidental grievance. There would be little outcry against the closed shop if it were closed in order to secure unity of purpose in constructive increase of production by offering to the employer the full value of the worker's mind and effort as well as his hands.

While it is easy to state that increased production will decrease cost and by providing a greater demand for goods secure increased consumption and ultimate greater employment, yet the early stages of this process do result in unemployment and great misery. It takes a variable period of time to create the increased area of consumption of cheapened commodities, and in the meantime, when this is translated to the individual worker he sees his particular mate thrown out of employment. We accomplish these results over long periods of time, but if we would secure co-operation to accomplish them rapidly we must take account of this unemployment and we must say to the community that if it is to benefit by the cheapening costs and thus the increased standard of living, or alternatively if the employer is to take the benefits, the entire burden should not be thrust upon the individual who now alone suffers from industrial changes. Nor can this be accomplished except by co-operation between groups.

I am not one of these who anticipates the solution of these things in a day. Durable human progress has not been founded on long strides. But in your position as a party of the third part to many of these conflicting economic groups, with your lifelong training in quantitative thought, with your sole mental aspect of construction, you, the engineers, should be able to make contribution of those safe steps that make for real progress.

Coal Output Per Miner.—The average production for each underground worker employed in the coal mines of the United States during 1918 was 1,134 short tons, according to statistics published by the United States Bureau of Mines. Our closest competitor is New South Wales, where each underground worker in 1918 produced 814 tons. The smallest individual output of recent years was that of Japan in 1917, with an average of 155 tons.



Ball Bearings for Railway Cars

During recent years ball bearings have been developed for use under very heavy loads and have been successfully applied under difficult conditions. The allowable pressure on ball bearings decreases as the speed increases and the adaptation of ball bearings to the high speeds and heavy loads met

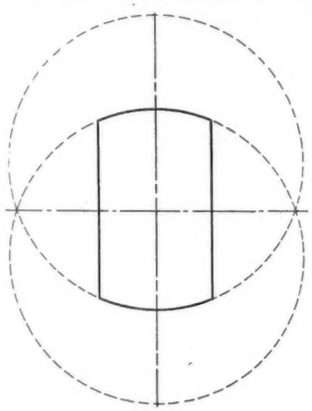


Fig. 1

in passenger cars is therefore a difficult problem. One of the latest developments is the application of a modified type of ball bearings in the trucks of passenger cars. This form of bearing is in service in Sweden and its use in this country is now being considered.

The use of ball bearings in railroad equipment was discussed in a recent paper before the Swedish Technological Society of Stockholm. The author of the paper, A. Danielson, pointed out that the advantages of ball bearings are due to the smaller loss of energy through friction, the lessening of danger of overheating, greater ease of handling, smaller consumption of oil and less attendance required. Where heavy loads are carried, roller bearings have come into competition with ball bearings, but the author pointed out that the coefficient of friction was higher and the saving of energy with the common types of roller bearings, compared with plain bearings, is often very small. Moreover, the application of most roller bearings is limited, due to the fact that very few types can take any end thrust.

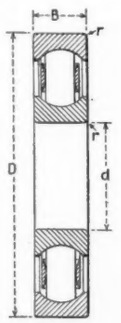


Fig. 2

Experiments conducted by Stribeck showed the coefficient of friction in roller bearings with spiral rolls was about 0.4 per cent and in a bearing with long cylindrical steel rollers between 0.7 and 1.4 per cent. The coefficient of friction in a ball bearing is 0.1 to 0.15 per cent. The increased friction of the roller bearing is due to the fact that the rollers tend to go crosswise, thus setting up a sliding motion. It is therefore desirable that the rollers in a roller bearing should be self-alined and, with this in mind, the so-called disk bearing manufactured by the Nordiska Kulluager Aktiebolaget (Northern Ball Bearing Company), Gothenburg, Sweden, was designed. It has been found that rollers of the form shown in Fig. 1 when moving between two planes have a peculiar rolling motion. Provided the upper plane can rise and fall, the horizontal axis will assume a normal position at right angles to the direction of motion. This also holds true when the disks move between round and not between plane surfaces, as in the disk bearing. By the form of roller shown, the strength of the roller bearing is combined with the easy running of the ball bearing, the effective capacity of the disc being the same as for a ball of the diameter shown by the dotted lines.

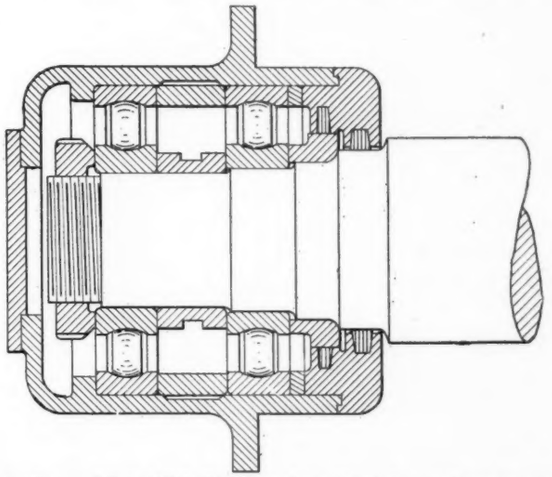


Fig. 3—Journal Box With Disc Bearings Used On the Swedish State Railways

The arrangement of the rollers or disks, as they are called, with the races and cage, is shown in Fig. 2. The race rings have concave grooves which conform fairly closely to the outline of the disks. As any axial displacement of the outer ring tends to compress the roller, such a bearing is able to carry a thrust load. Due to the self-alining feature, the disks adjust themselves at an angle so that the resultant pressure is normal to the axis of the disk. If the axial stress arises suddenly, the disk does not immediately adjust itself, but takes the stress nevertheless. The cage for disk bearings is so formed that the disks can adjust themselves under the influences of axial pressure.

The load capacity of the disk bearing is stated to be about 60 per cent greater than for ball bearings of corresponding

dimensions. The coefficient of friction is about 0.13 per cent, or about the same as for ball bearings. The design of disk bearing box used on the Swedish railways is shown in Fig. 3. On each journal are placed two bearings of the same type and dimensions which are coupled together so that they take up axial pressure in common.

In the absence of test data to show the saving effected by the reduction of friction, Mr. Danielson submitted calculations on a theoretical basis. The average resistance of the car with journal bearings was assumed to be as shown in

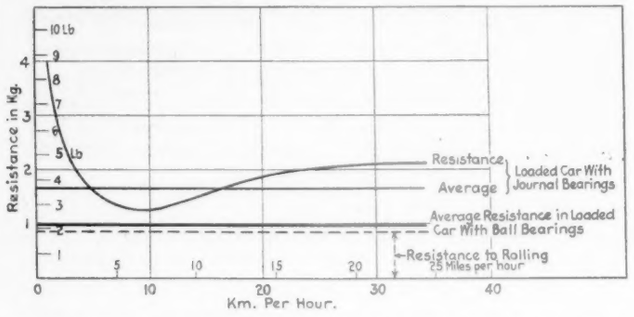


Fig. 4—Rolling and Total Resistance of Cars With Ball Bearings and Journal Bearings

Fig. 4, these curves being the results of tests of cars with plain and ball bearings conducted on the Swedish state railways. From these experiments modified on a basis of Stribeck's investigations of journal friction, the resistance curves for trains with disk bearings and with journal bearings have been derived as shown in Fig. 5. On the basis of a train consisting of an engine weighing 70 long tons with the weight of the tender and cars equal to 400 tons, operating over a given section of road, 200 kilometers long, the coal consumption was assumed to be 0.323 kilograms per car axle kilometer (1.15 lb. per car axle mile) and the price of coal

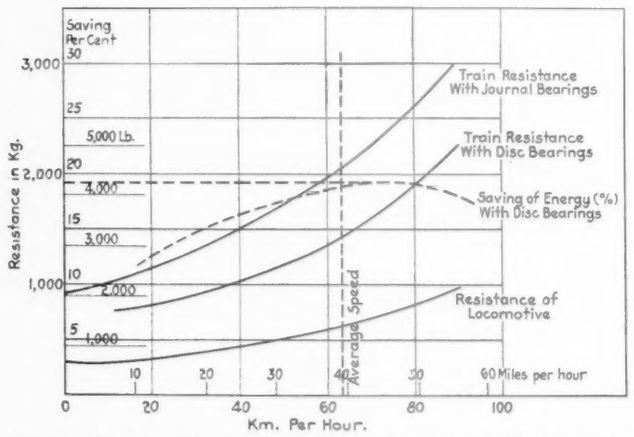


Fig. 5—Train Resistance With Journal Bearings and Disc Bearings and Saving of Energy

was taken at 155 kroner ($31.00) per ton.* Assuming an annual traffic of 140,000 car-axle kilometers, the saving amounted to 983 kroner (about $196.60) per car. On this basis, the saving would pay the cost of the new bearings in about a year and a half, including the expense of periodical overhauling.

In freight service, the percentage of coal saved would not be so great as the distance traveled in a year by each car would be less, but since the life of the bearings is likely to be greater, it is believed that even on freight cars disk bearings would prove economical. With freight cars the advantage of easier starting would assume greater importance.

*The normal value of the kroner is about 26 cents and the present value about 20 cents.

In ore traffic on the Swedish State Railways it has been established that the same engine with equal coal consumption is able to haul 28 or 33 cars provided with sliding bearings and ball bearings, respectively, on the line between Kiruna and Gellivare, equal to a coal saving of 18 per cent. On the line from Ripats to Lulea the corresponding numbers are 29 and 38 ore cars, equal to a coal saving of 31 per cent. On an electric road a four-axle car equipped with ball bearings has shown a saving of energy, measured in electric units, of 23 per cent.

The first car to which the disk bearings were applied weighs 36 tons, including the weight of passengers, which makes the pressure on each journal 4.5 tons. The car had covered 190,000 kilometers (118,000 miles) in fast passenger service on Nov. 9, 1920, and the original set of bearings was still in use.

The Swedish State railways have also had ball bearings in service since 1913 on cars weighing 42 and 43 tons, an average journal pressure of 5.2 tons. The first defect developed after the car had traveled 240,000 kilometers (149,000 miles). One car has been in service for two years without any defects in the bearings. Other companies are developing entirely new types of ball bearings and further improvements are anticipated.

Periodical Repairs for Freight Cars*

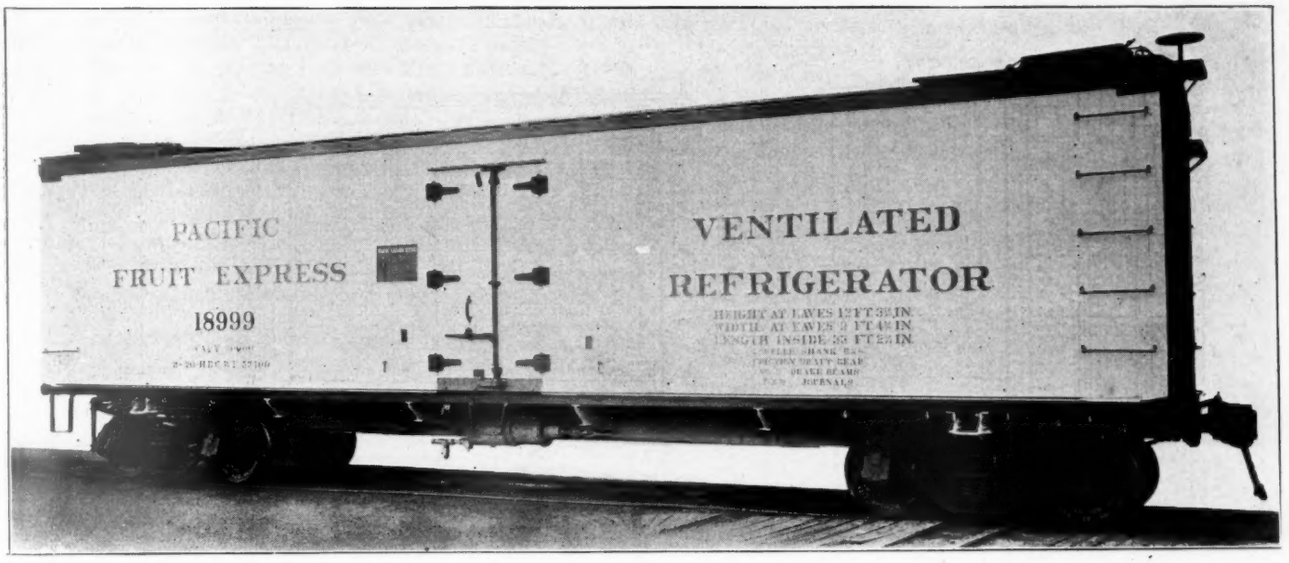
BY F. S. GALLAGHER
Engineer of Rolling Stock, New York Central

A freight car is constructed and the manufacturers are instructed to deliver it to some point where it is put in service and there it stays until it is about ready to drop to pieces. In the case of locomotive or passenger car it is different. Locomotives are usually brought into the shop and given designated repairs after certain mileage, and the same is true with the coach, but it is usually based on a time period. But the freight car, the most important of all vehicles, is put into service and given no attention whatever except the attention necessary to keep it in running condition and maintain safety appliances. Why should we not treat a freight car in the same manner as we do a passenger car or locomotive, by bringing it into the shop after a certain designated mileage, or after a certain length of service, and make certain repairs, thus always keeping the car in first-class condition?

This is a scheme which would take some study to work out properly, but when once worked out I believe would work to the advantage of the railroad company, because at all times we would know the condition of the equipment. To successfully work out a scheme of this kind would require the co-operation of all of the railroads in the country. If cars were stenciled in a manner to indicate during what period they should receive their periodical repairs, the railroad in whose possession the cars might be would be responsible to the owning road to see that the repairs are made or the cars are returned home for repairs. This would necessitate making it a requirement in interchange that the cars be either repaired or sent to the home road for repairs.

This periodical repair might not amount to much, it might possibly be painting or proper attention to the draft gear, or repairs to some of the brake apparatus, but it seems to me that there should be some designated time when a freight car should be brought into the shops for necessary repairs other than depending upon the judgment of the yard inspector as to whether or not the car should continue. I think we would have a large decrease in so-called heavy repairs and rebuilding if we could periodically bring the cars in and do certain things to them.

*From a paper presented before the New York Railroad Club.



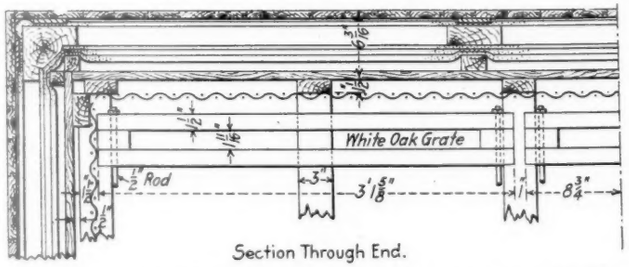
Pacific Fruit Express Refrigerator Cars

Insulation Around the Sides and Ends is Unbroken; A Continuous Layer of Cork in the Floor

THE Union Pacific has recently placed in service 4,000 refrigerator cars for the Pacific Fruit Express, 1,000 of which were built in the company's shops and orders for 3,000 of which were distributed among the following builders:

Pullman Company	900
American Car & Foundry Company	900
Haskell & Barker Car Company, Inc.	700
Mt. Vernon Car Manufacturing Company	300
Pacific Car & Foundry Company	200

These cars in general follow conventional lines of design



Horizontal Section Through the End and Side of the Car, Showing the Method of Carrying the Insulation Around the Corner

but possess a number of details of interest, notably the type and method of applying the insulation. The cars have the following general dimensions:

Length over sheathing	40 ft. 11⅛ in.
Length between ice tanks	33 ft. 2¾ in.
Width over sheathing	9 ft. 2⅝ in.
Width inside of lining	8 ft. 2¾ in.
Height, top of floor to ceiling	7 ft. 5⅛ in.
Cubic capacity between ice tanks	2,029 cu. ft.
Capacity of both ice tanks	10,500 lb.
Distance from center to center of body bolsters	30 ft. 8 in.
Truck wheel base	5 ft. 6 in.
Capacity	60,000 lb.
Truck capacity	80,000 lb.
Light weight of car complete (built up centre sill)	53,500 lb.
Light weight of car complete (Bettendorf)	52,200 lb.

The cars were built to two designs, differing only in the trucks and underframe construction. In one of these the Bettendorf single I section center sill and Bettendorf trucks are used while the other involves a double fish belly center sill built up of plates and structural sections, and is carried on Vulcan trucks.

Underframes

The principal member of the Bettendorf underframe is an 18-in., 92-lb. Bethlehem girder, the depth of which is reduced to 14 in. at the bolster. The bolster is an 8-in., 34.5-lb. H-section, which is framed through the center sill and the rear ends of the draft sill castings.

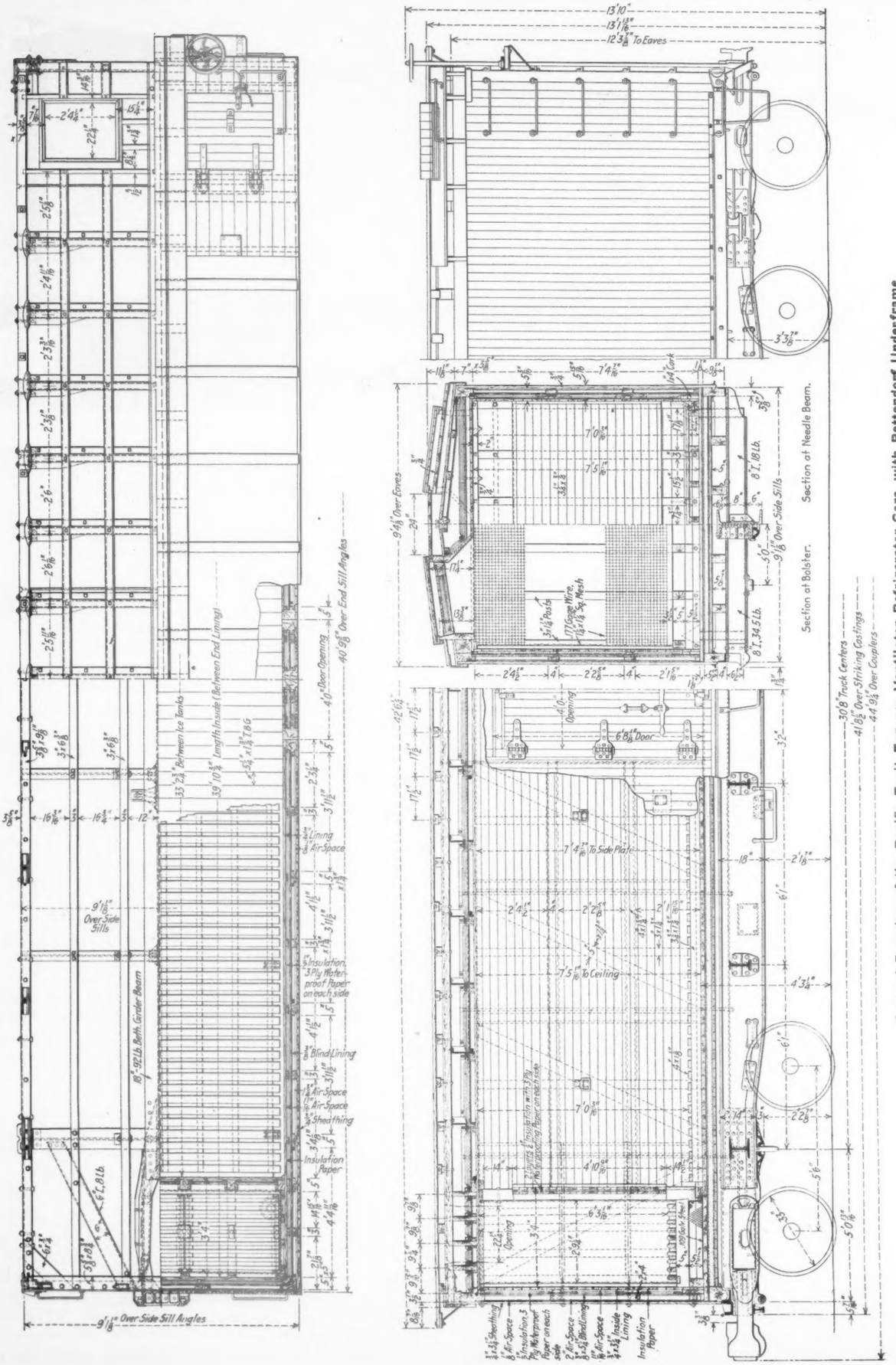
The center sills of the other underframe are built up of 5/16-in. web plates with 3-in. by 3-in. by 5/16-in. angle flanges at the top on the outside only and 3-in. by 3-in. by ¼-in. angle flanges on the inside and 3-in. by 3-in. by ½-in. angle flanges on the outside at the bottom of each plate. The sills are completed with two ¼-in. superimposed top cover plates, the lower one extending the entire length of the sills and the other extending 8 ft. toward each end from the transverse center line of the car. The bolsters on this underframe are also of built up box section; the 5/16-in. web plates are spaced 8 in. back to back and reinforced with 2½-in. by 2½-in. by 5/16-in. angles on the outside at both top and bottom. The bolsters are completed with top and bottom cover plates, the latter being continuous and are attached to the center sills on either side with one horizontal and two vertical corner angles.

In other respects the two underframes are similar. Both have four 8-in., 18-lb. I-section needle beams, and in each case the end and side members are 4-in. by 4-in. by ⅜-in. and 4-in. by 3-in. by ⅜-in. angles, respectively.

The Car Bodies

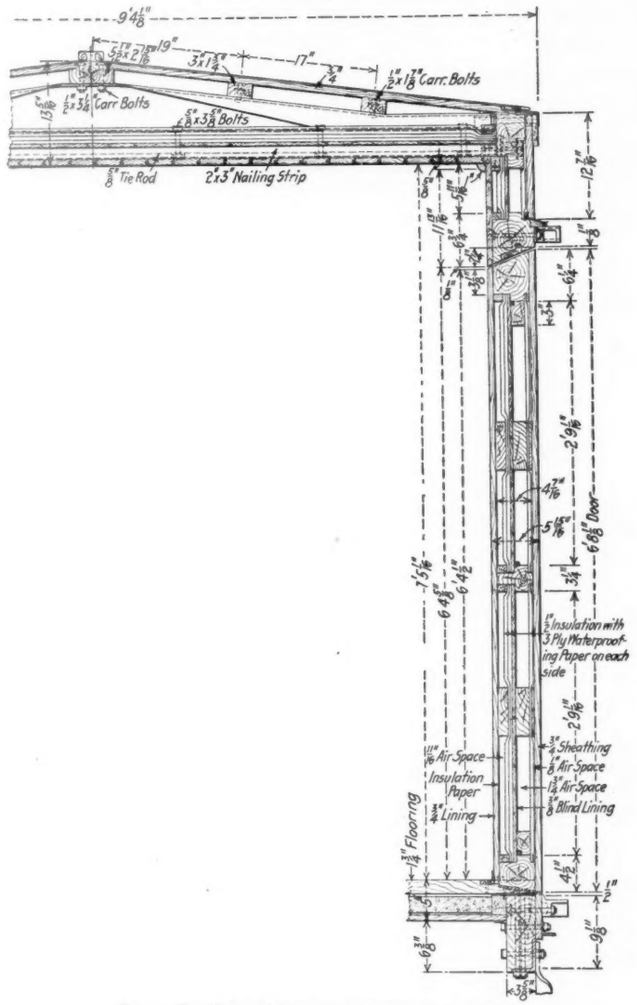
The construction of both car bodies is essentially the same. Both have wood frames with the exception of the carlines, which are of pressed steel. The bodies are built up on wood sub-sills; those for the sides and ends are framed into and bolted to the angle members of the steel underframe; while the intermediate sills are bolted on top of the needle beams.

The entire floor construction is placed above the inter-


13'10"
13'1 1/16"
12'3 3/8" To Eaves
Section at Needle Beam.
Section at Bolster.
8 T. 18 Lb.
8 T. 34 Lb.
9'1 3/8" Over Side Sills
9'4 3/8" Over Eaves
40'9 5/8" Over End Sill Angles
39'10 3/4" Length Inside (Between End Lining)
9'1 1/8" Over Side Sill Angles
18" 92 Lb. Beth Girder Beam
2" Lining
8" Air Space
5" Insulation, 3 Ply Waterproof Paper on each side
Blind Lining
Insulation Paper
7'4 7/16" To Side Plate
7'5 1/16" To Ceiling
6'8 1/8" Door
4'10" Opening
308" Truck Centers
41'8 3/4" Over Striking Castings
44'9 3/4" Over Couplers

General Drawing of the Pacific Fruit Express Ventilator Refrigerator Cars, with Bettendorf Underframe

mediate sub-sills with no enclosed air spaces, which makes it possible to provide continuous floor insulation. The lower floor is ¾-in. tongued and grooved material nailed directly to the top of the intermediate sub-sills, the ends of the boards resting on 1½-in. by 1½-in. angle supports bolted to the inside faces of the side sub-sills. This floor is covered with a ¼-in. coat of Sarco Bituminous Seal, applied hot. A 2-in. course of Nonpareil Cork Board is then laid while the bituminous compound is still hot and this is sealed with another ¼-in. coat of the hot waterproof compound. The insulation thus built up is covered with a layer of Peerless mica surfaced insulating paper with the seams carefully joined to prevent moisture passing through and the

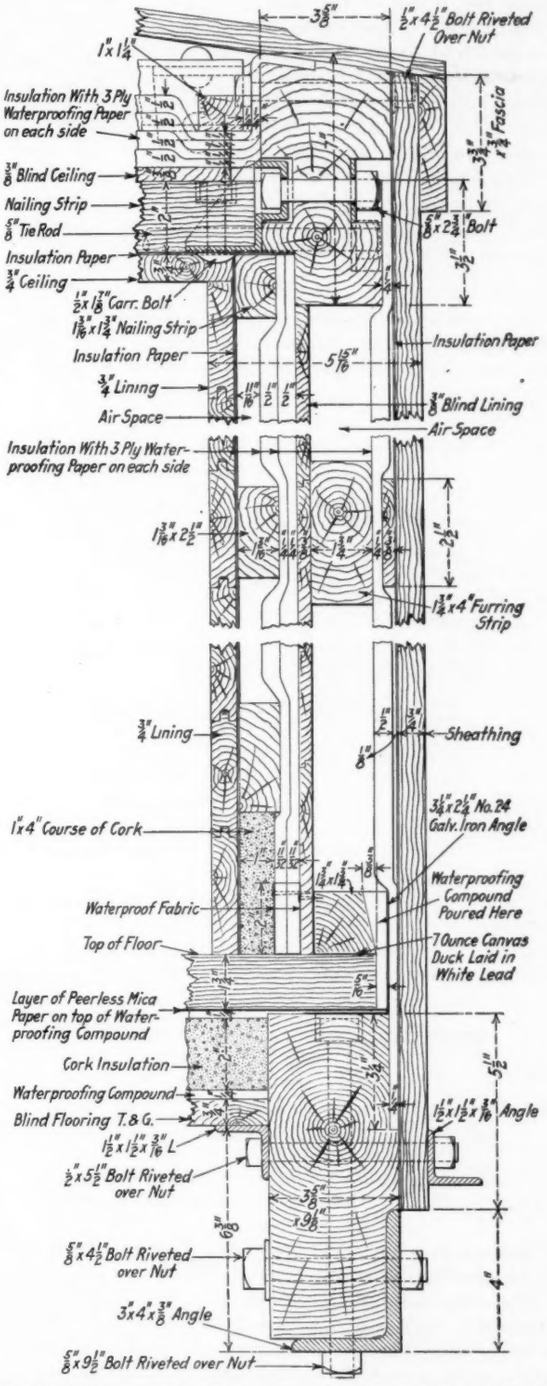


Cross Section of the Car Body at the Door

upper floor, of 1¾-in. tongued and grooved material is then laid. The ends of the flooring are nailed to the tops of the side sub-sills and the boards are further secured by nailing through the insulation into the two center sub-sills.

The side construction provides three air spaces between the inside lining and the sheathing. The first course of insulation, consisting of one layer of ½-in. Keystone hair felt between courses of three ply, waterproofing paper is placed outside the frame before the outside sheathing is applied. This insulation, as is shown in one of the drawings, extends continuously from door post to door post around each end of the car and is secured to the frame members by ⅜-in. nailing strips. After a layer of Per Bona insulating paper, also extending continuously from door post to door post, has been laid over the nailing strips, the sheathing is applied. There is a nominal air space of ⅛-in. between the unrestrained portions of the insulation and the sheathing.

An intermediate lining of ⅜-in. ship lap material is nailed to the inside of the frame members, and against this is laid the inside insulation, consisting of two thicknesses of the hair felt covered on each side with three-ply waterproofing paper. This extends continuously around the ends of the


3 5/8"
1/2" x 4 1/2" Bolt Riveted Over Nut
1" x 1 1/4"
Insulation With 3 Ply Waterproofing Paper on each side
3/8" Blind Ceiling
Nailing Strip
5/8" Tie Rod
Insulation Paper
3/4" Ceiling
1/2" x 1 7/8" Carr. Bolt
1 3/16" x 1 3/4" Nailing Strip
Insulation Paper
3/4" Lining
Air Space
3 3/4" Fascia
5/8" x 2 3/4" Bolt
3 1/2"
Insulation Paper
5 15/16"
3/8" Blind Lining
Air Space
Insulation With 3 Ply Waterproofing Paper on each side
1 3/16" x 2 1/2"
2 1/2"
1 1/4" x 4" Furring Strip
3/4" Lining
Sheathing
1" x 4" Course of Cork
3 1/4" x 2 1/4" No. 24 Galv. Iron Angle
1/4" x 1 1/8"
Waterproofing Compound Poured Here
Waterproof Fabric
Top of Floor
7 Ounce Canvas Duck Laid in White Lead
Layer of Peerless Mica Paper on top of Waterproofing Compound
Cork Insulation
Waterproofing Compound
Blind Flooring T. & G.
1/2" x 1 1/2" x 3/16" L
1/2" x 5 1/2" Bolt Riveted over Nut
3 3/8"
1 9/16"
6 1/8"
5/8" x 4 1/2" Bolt Riveted over Nut
3" x 4" x 3/8" Angle
5/8" x 9 1/2" Bolt Riveted over Nut
5 1/2"
1 1/2" x 1 1/2" x 3/16" Angle
4"

Section Through the Side of the Car, Showing Details at the Junction of the Side With the Ceiling and Floor

car from door post to door post, and is held in place by 1-3/16-in. nailing strips over which is placed a continuous covering of Per Bona insulating paper before the inside lining is applied.

In the bottom of the side and end walls, a strip of 1-in.

by 4-in. cork board is laid on top of the floor between the inside lining and the inside layers of insulation. This is held in place against the floor by a 1-3/16-in. belt strip placed directly above it. To further protect the insulation and the concealed wood work at the floor line from the penetration of moisture, the lower edges of the two inside layers of hair felt are enclosed in a waterproof cotton fabric placed under the edges of the insulation and folded up the sides for a distance of two inches above the floor; the nailing strips for the blind lining at the floor are covered with canvas laid in white lead on the floor and lining sides, and the 5/16-in. spaces between the ends of the floor boards and the outside faces of the side sills are filled with hot waterproofing compound extending up 3½-in. to the top of the blind lining nailing strips. The doors are built up with the same arrangement of insulation as that in the sides of the car. They are fitted with Miner fasteners and insulation for the joints between and around the doors.

The Roof

The cars are fitted with the Murphy X L A outside metal roof and, with the exception of those at the ends of the hatchways, the car-lines are of pressed steel of inverted U-section with one side extending down to form a support to which the ceiling structure is bolted.

The roof insulation consists of four layers of the ½-in. hair felt insulation, covered on each side with three-ply waterproofing paper. This insulation is placed between the steel car-lines and the blind ceiling, which is built up of ⅜-in. ship lap material on top of 2-in. by 3-in. transverse nailing strips. On the lower face of the nailing strips the ¾-in. tongued and grooved ceiling is applied and the whole structure is secured to the car-lines by ⅝-in. bolts.

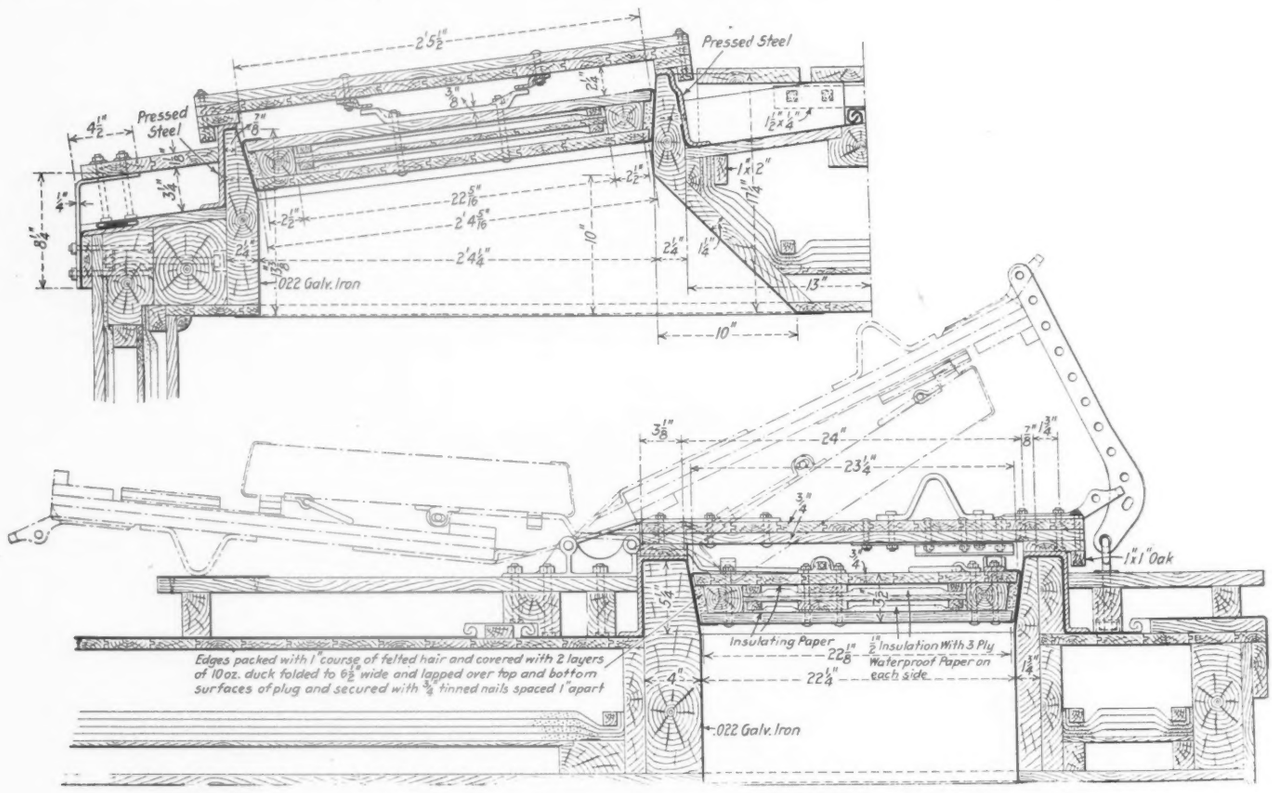
The details of the construction of the hatchway openings and the methods of securing the insulation at these points are shown in the drawings. The hatch covers and plugs are both hinged from single sets of hinge fixtures with separate hinge connections and they are arranged so that the hatches may be opened for ventilator service. The cover is held open by a simple adjustable support and the plug is supported from the cover by a sliding attachment, normally not connected, but easily brought into play when both are fully opened.

The Bunkers

The bunkers are enclosed by a bulkhead, the outside face of which is 3 ft. 4 in. from the end lining. The bulkhead is built up on 3-in. by 4-in. oak posts and consists of two courses of ¾-in. tongued and grooved material separated by two ½-in. thicknesses of hair felt insulation covered with three-ply waterproofing paper. The first course is laid against nailing strips between the posts and the outer course is nailed directly to the faces of the posts. The top bulkhead opening is 14 in. deep and the bottom 12 in.

The ice tank is fitted with a floor pan of galvanized steel and the lining of the end and sides of the car is covered with galvanized iron from the floor pan flashing to the ceiling.

The galvanized wire ice basket is spaced 1½ in. from the end lining, 1⅝ in. from the side linings and is attached directly to the inside faces of the bulkhead posts. The bottom of the basket is closed with an oak grate made up of 3½-in. by 1½-in. bars extending across the car and supported on six supports of 3-in. by 5-in. oak, the tops of which are 10½ in. above the floor.


Pressed Steel
Pressed Steel
.022 Galv. Iron
1"x1" Oak
Insulating Paper
½" Insulation With 3 Ply Waterproof Paper on each side
Edges packed with 1 course of felted hair and covered with 2 layers of 10 oz. duck folded to 6½" wide and lapped over top and bottom surfaces of plug and secured with ¾" tinned nails spaced 1" apart
.022 Galv. Iron

Transverse and Longitudinal Sections Through the Hatch, Showing Method of Ventilating the Car

The floor racks are built in two longitudinal sections at each end of the car, hinged at the sides to swing up against the lining. Each section is supported on four 1¾-in. by 3¾-in. longitudinal members and is made up of 1⅛-in. by 4-in. boards spaced 1-9/16-in. apart.

The trucks on the cars with the built up underframes have Vulcan side frames and Buckeye bolsters, the ends of which rest on Barber roller spring seats. The axles have 5-in. by 9-in. journals and the trucks are fitted with Creco No. 2 brake beams.

Annual Report of the Chief of the Bureau of Safety

Defective Air Brakes Still Constitute Majority of Safety Appliance Defects; Two Devices Tested

THE percentage of cars found defective, as shown in the annual report of the chief of the Bureau of Safety for the year ending June 30, 1920, is higher than any of the past five years. However, there is some improvement in the statistics of casualties to employees for the year 1919 as compared with 1918. The recommendations made by the chief of the bureau in previous years regarding the maintenance of air brakes and the control of freight trains on heavy grades by air brakes exclusively are repeated. A brief summary of the report is given below.

Safety Appliances

The following statement affords opportunity for ready comparison of the results of inspections with previous years. It has been compiled from the figures for the fiscal years ended June 30, from 1915 to 1920, inclusive.

	1916	1917	1918	1919	1920
Freight cars inspected...	968,566	1,100,104	1,059,913	1,023,942	864,775
Per cent defective.....	3.72	3.64	3.92	3.7	4.59
Passenger cars inspected.	27,220	29,456	25,732	23,712	19,849
Per cent defective.....	1.82	0.85	0.56	0.39	0.77
Locomotives inspected...	31,721	37,199	33,806	30,707	23,883
Per cent defective.....	3.66	2.69	2.18	1.84	2.38
Number of defects per 1,000 inspected	45.56	41.16	44.01	40.92	52.08

As shown by this summary, the number of cars inspected was less than for the preceding years, but the percentage for each class of equipment, as well as the number of defects found per thousand inspected, have materially increased. The decrease in the number inspected was occasioned by the numerous special investigations which the inspectors were called upon to make during the year, thus rendering it impossible to devote as much time as heretofore to regular inspection work. The proportionate increase in defects reported is attributed largely to the abnormal operating conditions which existed during the year, resulting in the use of equipment regardless of its age or condition and its continuance in service without necessary repairs, these conditions being aggravated by inadequate shop facilities and repair forces.

Of the total of 47,319 defects of all classes, 3,791 were to couplers and parts, 5,035 to uncoupling mechanism, 22,375 to air brakes, 4,049 to handholds, 1,940 to height of drawbars, 557 to sill steps, 1,444 to ladders, 2,399 to running boards, 5,507 to hand brakes, 36 to safety railings, 130 to footboards, 12 to pilot beam sill steps, 36 to handrails, 3 to steps for headlights, and 5 to power brakes on locomotives.

It will be noted that air-brake defects continue to represent by far the most numerous class. Nearly 50 per cent of all defects reported were to visible parts of air brakes, more than 20,000 of these defects being found in but five parts. The number of cars with brakes cut out of service continues unduly large. Of the 22,375 air-brake defects reported, 7,344, or nearly 33 per cent of the whole number, were cut-out brakes. At numerous terminals it is a common occurrence for cars with cut-out brakes to be made up in trains and permitted to depart in that condition, although facilities exist at such terminals for making necessary repairs to place all power-brake equipment in operative condition. This practice should be discontinued.

The condition of the air brakes in trains prior to departure, as ascertained by the commission's inspectors by means of terminal or standing tests, is tabulated in the report. This table shows the results of tests of 938 trains, composed of 30,578 cars. The brakes on 94.7 per cent of these cars were in operative condition when the trains tested departed from the terminals. Of the total number of cars, there were 5 nonair cars, 178 cars with the brakes cut out, and 1,431 cars on which the brakes did not apply, making a total of 1,614 cars on which the brakes were not operative when leaving terminals.

Another table represents the condition of the air brakes, as ascertained by the commission's inspectors by means of terminal or standing tests, upon arrival of trains at terminals. This table shows that in 149 trains, consisting of 5,819 cars, the brakes were operative on 88 per cent of the cars. Of the total number of cars in these trains there were 194 with the brakes cut out and 477 on which the brakes did not apply, or 671 cars with inoperative brakes. This table shows that of 41 roads on which arriving tests were made there were 14 on which trains did not have an average of 85 per cent operative brakes. It is apparent that the law is not being complied with as to the minimum percentage prescribed by the order of the commission of June 6, 1910, nor as to the requirement that all air-brake cars associated with the minimum percentage must also be used and operated. The arriving tests show the condition of air-brake equipment from a practical operating standpoint. Carriers should take necessary measures to insure strict compliance with the law and see to it that trains at all times are operated not only with the minimum percentage of operative brakes specified by law, but also with all associated air brakes used and operated.

On March 2, 1920, application was filed by the American Railroad Association for a further extension of time within which to equip cars in service on July 1, 1911, to conform to the standards of equipment prescribed by the commission's order of March 13, 1911. This application for an extension of time was denied by the commission on August 7, 1920.

The report calls attention to violations of the Safety Appliance Act occurring at interchange points. One carrier delivers cars to another with defective safety appliances and the receiving carrier moves the cars to its yard, thus making two violations of the law. Adequate inspection and proper repairs prior to assembling cars for interchange movement are recommended to eliminate this difficulty. The practice of permitting defective cars to accumulate and making them up in a train for movement to a repair point is also condemned. Recently two suits were instituted against carriers for movement of trains of this nature.

The handling of logging trains is again referred to and the chief inspector states, in view of the conditions existing, the law should be amended by placing further restrictions upon the operation of such trains.

Mention is again made of the handling of trains down heavy grades by means of hand brakes supplemented by air brakes. Suits are being instituted for the purpose of compelling strict observance of the law. A statement is made that controlling trains by air brakes alone is the safer and better practice and is dependent merely on proper maintenance of air brake equipment. Defective hand brakes are also mentioned as the source of many suits.

Summary of Casualties

The casualties on steam railroads in connection with the operation of trains during the calendar year 1919 are summarized in the table shown on the following page.

In addition there were 483 persons killed and 96,452 injured in nontrain accidents during the year, in comparison with 589 killed and 110,431 injured during the previous year.

During the calendar year 1919 there were 108 employees killed and 1,975 injured in coupling or uncoupling locomotives or cars, as compared with 164 killed and 2,332 injured during 1918. Casualties to employees in 1919, due to coming in contact with fixed structures, resulted in 56 deaths and

Class of persons	Number of persons Killed	Injured
Trespassers	2,553	2,658
Employees	1,759	36,601
Passengers	273	7,456
Persons carried under contract, such as mail clerks, Pullman conductors, etc.	28	691
Other nontrespassers	1,882	5,195
Total of above classes	6,495	52,601

1,009 injuries, the corresponding figures for 1918 being 83 and 1,367. In 1919 there were 97 employees killed and 6,219 injured in getting on or off cars or locomotives.

During the year ended June 30, 1920, 90 train accidents were investigated by this bureau, consisting of 58 collisions and 32 derailments. The collisions resulted in the death of 179 persons and the injury of 1,158 persons; the derailments resulted in the death of 60 persons and the injury of 481 persons, a total of 239 killed and 1,639 injured.

Investigation of Safety Devices

During the year tests were conducted of the device of the United States Train Signal Co., of Portland, Me. This device is an electropneumatic signal system providing means of transmitting signals between the cars and the locomotive in a train, and vice versa. It consists of electropneumatic valves controlled by a series circuit, one valve being installed in each car or locomotive cab, and provided with indicators, both audible and visual, which are operated when the circuit is interrupted; circuit controllers for operating the device are provided in each car and locomotive. The examination and tests of this device demonstrated that visual and audible signals, which are displayed and sounded simultaneously on each equipped vehicle, can be transmitted as rapidly as the circuit controller can be operated; and signals can be acknowledged by engine crew or transmitted from engine crew to train crew without the use of the locomotive whistle.

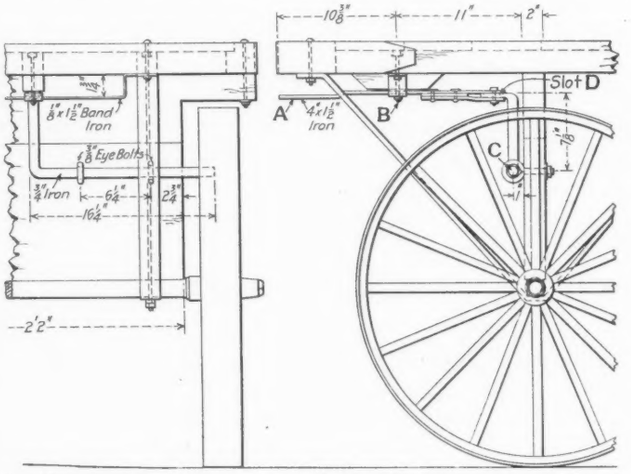
An inspection has been made and demonstrations witnessed of the automatic connector of the Robinson Connector Co., New York, N. Y., as installed on passenger equipment of the New York Central operating between Dunkirk, N. Y., and Titusville, Pa. This connector is of the butt face, straight port type, with wing type guiding members, which form the gathering and registering devices. As a result of the inspections and demonstrations of this device, the Robinson connector is considered well adapted to accomplish its intended functions when used on passenger-train equipment. The few irregularities of operation noted during these demonstrations were without exception due to details of construction and installation which can readily be improved. The use of gaskets of special design is undesirable from an operating standpoint. It is believed the gathering range and registering means employed by this device are adequate and reliable and that with this connector tight joints can be maintained.

Preliminary steps have been taken and plans are being formulated for the administration of section 26 of the interstate commerce act, conferring upon the commission authority to require the use of automatic train stop or train control devices and other safety devices in designated locations and to prescribe specifications and requirements therefor.

The report includes the usual tabulation showing the results of the inspection of safety appliances and tests of air brakes on trains arriving at and departing from terminals. Numerous judicial interpretations of the safety appliance law are summarized in the report.

Locking Device Applied to Station Baggage Trucks

It occasionally happens that baggage trucks when left on slight inclines start of their own accord and occasion more or less damage by running into and injuring passengers. Sometimes trucks are started unintentionally by persons bumping into them. To prevent the possibility of accidental starting, a locking device has been developed and put into use on baggage trucks on the Chicago, Milwaukee & St. Paul. A sketch of the detailed application of this device is shown in the illustration. The lock *C* consists of a piece



Locking Device Applied to Chicago, Milwaukee & St. Paul Baggage Trucks

of ¾-in. round iron, bent at right angles and guided by two ⅜-in. eye bolts. In order to lock the truck this iron is extended between the wheel spokes, and when moved back out of the way the truck is unlocked and free to move. Movement of the locking bar *C* is controlled by the handle *A*, pivoted at *B*. The slot *D* prevents any binding action and the handle *A* moves freely when it is desired to lock or unlock the truck. The handle *A* is supported by and slides on a band of ⅛-in. by 1½-in. iron. The entire locking device is under the truck, out of the way, and has proved most efficient for the purpose for which it was designed.

The Main Shop of the A. E. F. at Nevers, France

An Efficient Car Straightening Frame

Counterweighted Jacking Beams, Power Jack and Winch Facilitate Work on Steel Cars

BENT end sills, bulged sides, damaged corners and buckled cars are bugbears for shops that repair steel freight equipment. Sledging or jacking the parts into position involves much hard work and oftentimes an indifferent job results. Jacking frames are now widely used for this class of work and with good success. To facilitate the operations performed with this appliance, N. B. Messimer, superintendent of the Avis, Pa., shops of the New York Central, devised an ingenious arrangement for using a power jack.

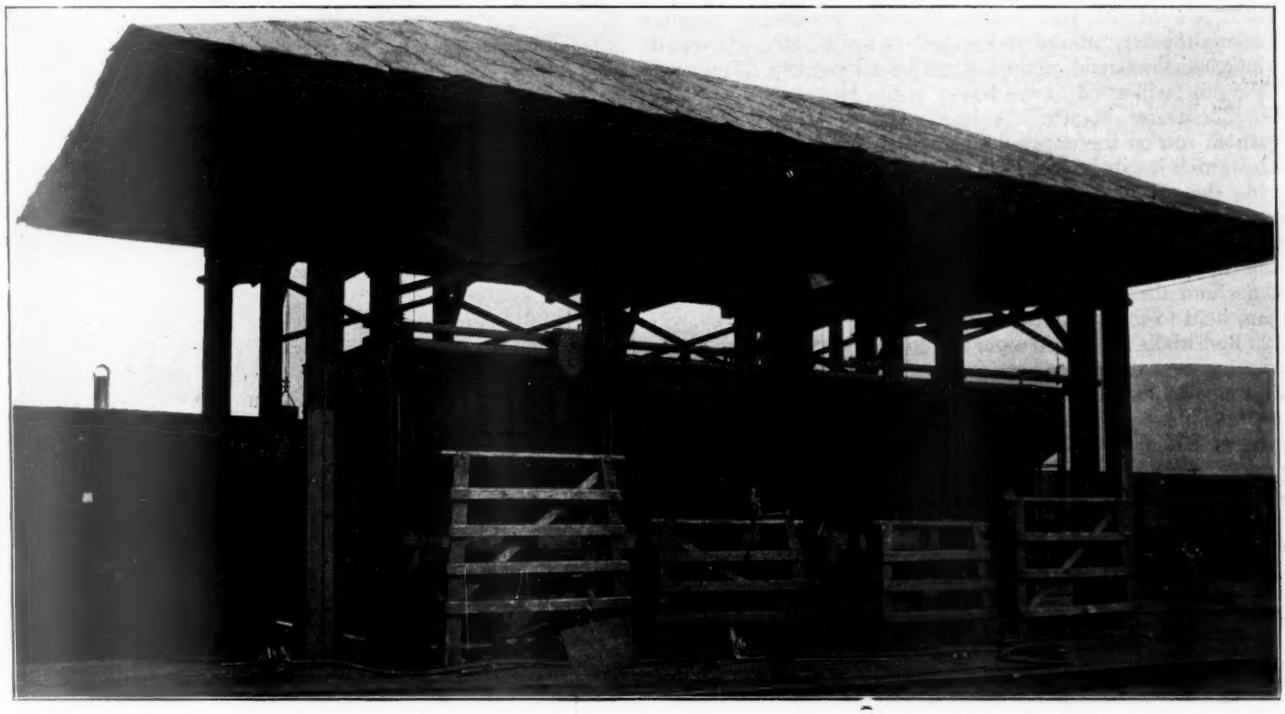


Fig. 1—Jacking Stall at Avis Shops, Showing Jacking Bars and Power Operated Jack

The jacking stall itself consists essentially of a structural steel framework of sufficient strength to withstand the stresses when pulling or jacking with the car blocked against the frame. A general view of the stall is shown in Fig. 1 while Fig. 4 shows the details of the structural work. Figs. 5 and 6 show the appliance used for straightening by means of an air motor which forms the unusual feature of this installation. In straightening the bent parts of cars, the jacks or blocks are placed against movable horizontal jack beams.

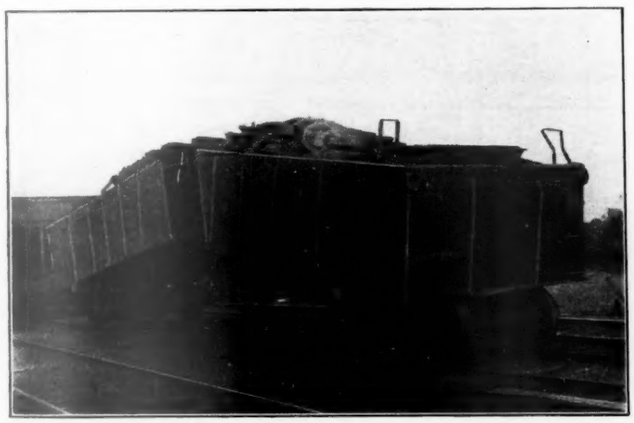


Fig. 2—A Badly Buckled Car as Received for Repairs

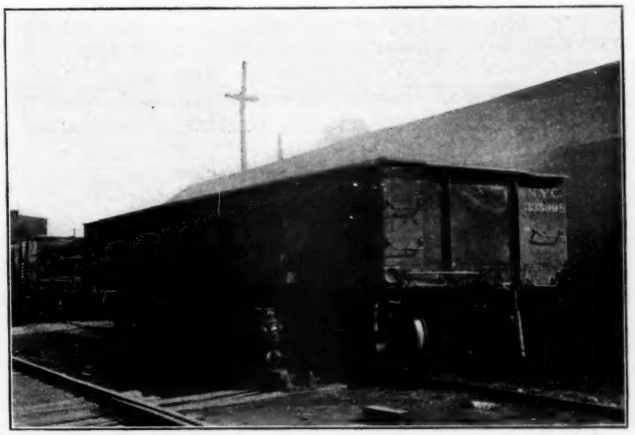


Fig. 3—Car Shown in Fig. 2 After Being Straightened

The side jack beams are made of two 8 in., 16.75 lb. channels riveted to spacing blocks, each of which has a 1¾ in. rod extending between the vertical posts. By tightening the nuts extending between the vertical posts of the jacking frame.

on these rods, the jack beams can be securely held in position. The end jack beams are of similar design; but since the distance between the center of the posts is greater, they are made of 10 in., 30 lb. channels. Each jack beam is counterbalanced by two weights attached to wire ropes which pass over sheaves keyed to a 1¾ in. shaft mounted above the top tie beam as shown in Fig. 4. This facilitates raising or lowering the jack beam and keeps it horizontal.

On the jack beam is mounted a pneumatically operated jack as shown in Figs. 5 and 6. This consists of a train of gears driven by an air motor and operating a large gear having a recess in the hub for a 1½ in. hexagon nut and a two-inch hole through the center of the gear. A threaded keybolt is passed through the gear and between the two channels of the jack beam. Various hooks for reaching across the car, around end stakes, end sills, etc., are readily attached to the end of the keybolt by a loose key, after which the nut is inserted in the recess in the jack gear.

The frame holding the jack gears is fitted with rollers which run on the upper flange of the jack beam and clamps by which it can be locked to the lower flange. In straightening the cars, the jack beam is placed adjacent to the part where the stress is to be applied and it is blocked in such a manner that by pulling with the power jack, the part can be straightened. Journal jacks are often used for blocking the cars and these have lugs welded to the base by which they are held to the jack beams.

Bad kinks, as for example a crumpled corner, require heating, after a strain has been imposed, to insure a good smooth job. The majority of straightening, however, can be done cold by properly blocking the car or portion of the car being worked upon and then pulling with the motor gear box or jacking with ratchet jacks.

That this car straightening jack will take care of the big

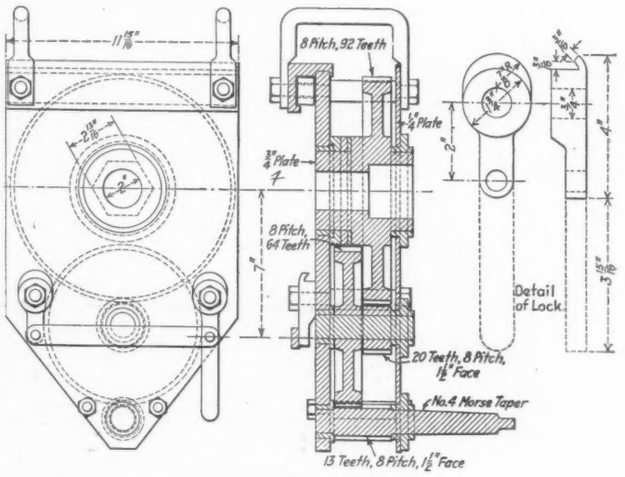


Fig. 5—Details of the Jack Gear

job as well as the small kinks is evidenced by the repairs to a steel gondola which was badly buckled in a wreck. This gondola (Fig. 2) was placed upside down on a pair of trucks for convenience in working and run into the straightening

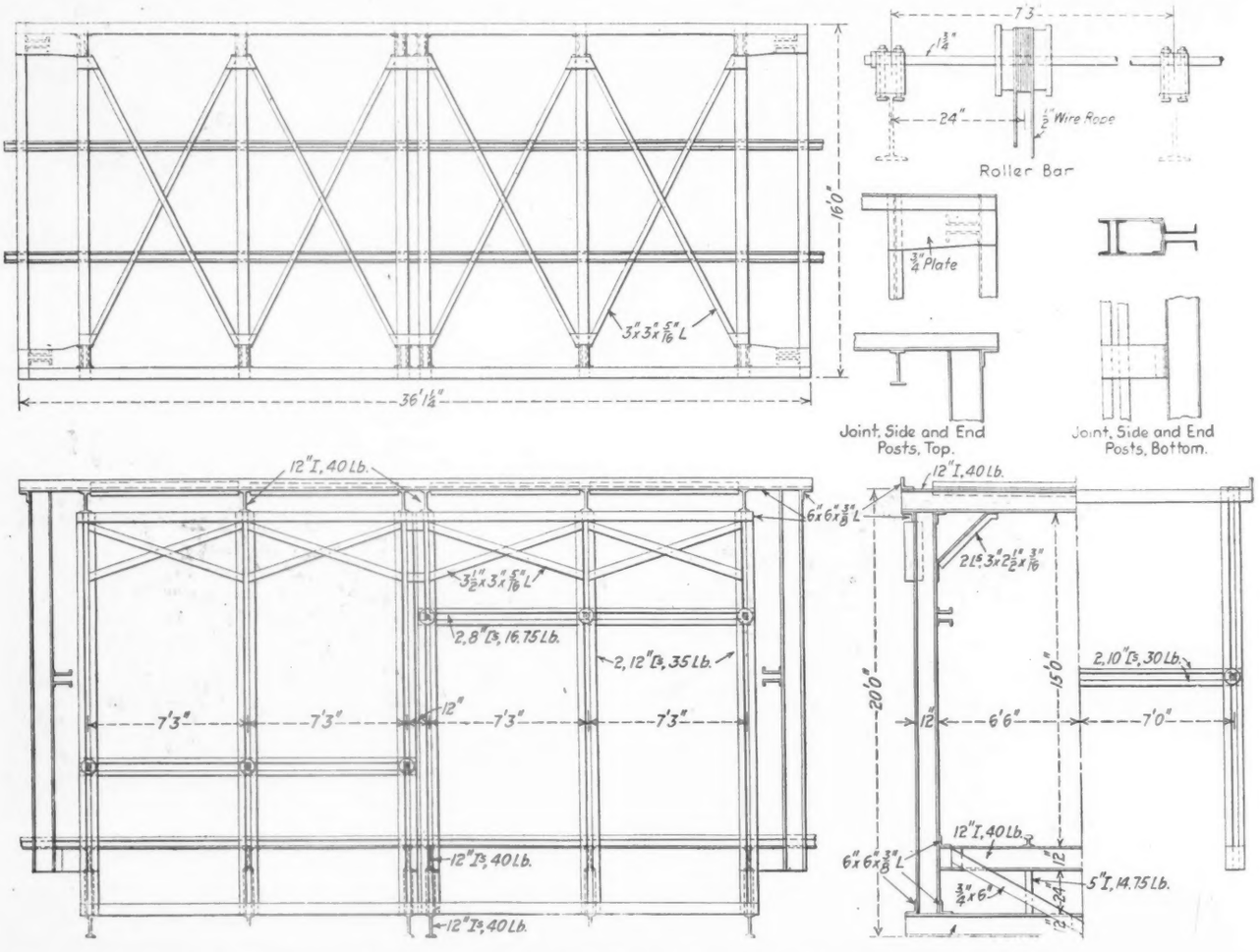


Fig. 4—Assembly Drawing of Jacking Stall Showing Arrangement of Structural Steel Parts

frame. The car straightened and ready for service is shown in Fig. 3. Close inspection will show the reinforcing angle along the top of the side, the use of which has been found to be advisable in stiffening a badly crumpled sheet. While this method of straightening avoids the bad effects of heating sheets, a sheet that has been bent is not as stiff or strong

Fig. 6—Power Jack in Position to Straighten the Side of a Hopper Car

as the original plate; consequently, this stiffening angle is often added after straightening.

An interesting device used in connection with the jacking

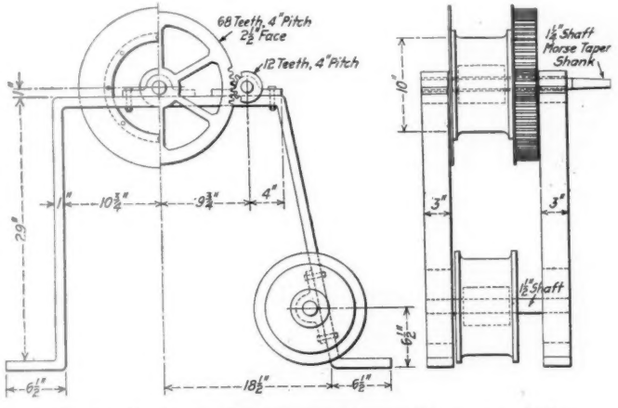


Fig. 7—Winch for Pulling Cars Operated by Air Motor

frame is the motor winch shown in Fig. 7. This is located beside the track at the end of the stall and is used to pull cars by means of a rope passing around a sheave which is driven through gearing by an air motor.

PREVENTING THEFT FROM FREIGHT CARS.—There is one thing that would help to reduce theft and that is to make it physically hard to break into cars. The seal we put on a car door offers no resistance. The morale of the people who pilfer cars is not such as to deter them with merely a seal and, therefore, it would seem that physical resistance to their entrance to the car would offer us the greatest amount of protection.—*D. R. MacBain, before the Western Railway Club.*

Lubrication of Freight and Passenger Equipment*

BY M. J. O'CONNOR
Mechanical Inspector, New York Central

The subject assigned the speaker is fully realized as one of the most important subjects that the railroads have to contend with at the present time, and one of the most expensive in the operation of their trains, both passenger and freight. My experience as a special lubrication inspector for the past twelve years with the New York Central Lines, leads me to believe that we should not take any radical action in the handling of lubrication without careful and due consideration, especially after we have proven that the methods shown to be satisfactory are in vogue.

The practices of the trunk lines that I have the honor to represent are more or less, briefly speaking, as follows:—The journal box packing used by our company is prepared on a standard 48 hr. basis for saturation. The equipment used in connection with this material consists of metal tanks equipped with screens located about two inches from the bottom and is fitted with 1¼-in. faucets which are used in draining off the surplus oil which is placed in the tank during the process of saturation. For example, we place 50 lb. of dry waste in the tank and submerge same in 60 gallons of oil. After same is thoroughly saturated in accordance with our standard practice, we drain off 35 gallons of oil, thus leaving 25 gallons of oil, or four pints of oil for each pound of dry waste so saturated. The draining off of this surplus oil automatically makes the preparation tank a storage tank and the faucet is then used for drawing off the oil that settles in the bottom of the tank. This oil is poured over the packing several times daily until all of the material is used. By this method, we are reasonably sure that such packing contains four pints of oil to each pound of waste when placed in journal boxes under cars.

It is not our custom to use any free oil in the handling of freight trains as prepared packing is used almost exclusively in shops, terminals and enroute in trains.

The packing that we use and from which excellent results have been obtained, also a much better service performance, consists of a cotton-wool mixture, which is our standard journal box packing at the present time. Briefly outlined the reason for favoring the combined cotton-wool preparation, is the fact that our men know at all times when adjusting the packing in the boxes on cars in trains whether or not it is carrying sufficient oil, which cannot be determined with the all-wool waste so readily, for the reason that the wool waste will not hold the oil in suspension, thus depriving the metal of the proper lubrication that the combined cotton-wool waste gives it on the start.

Many papers have been prepared on this most important subject, and the idea is that the discussion will bring out many points of interest that I shall be very glad to reply to when propounded.

The mileage on the system that I represent runs on an average as follows:

Freight—31,000 miles per car per hot box for the year 1919.

Passenger—170,000 miles per car per hot box for the year 1919.

The figures shown for the passenger performance represents mileage on the very highest class of trains. The service performance on our local passenger trains was still better and averaged more than 650,000 miles per car per hot box during the year 1919.

With reference to the freight car performance, we averaged approximately one hot box on less than one-quarter of one per cent of the cars handled during the year 1919.

*A paper presented at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association.

I sincerely hope that the points brought out fully meet the question and will cause an extensive discussion for the welfare of the service throughout the United States and Canada.

Discussion

B. F. Patram (Southern): We have what we term standard saturation tanks, with faucets. We have a tank that holds 50 lb. of dry waste which is saturated with 60 gallons of oil. We leave it for 48 hours or longer, sometimes a week, then draw off 35 gallons of the oil. As the material is used the effort is made to maintain the proportion of four pounds of oil to one pound of waste.

T. S. Cheadle: What is done in reference to conserving the portion that is taken out on the repair track? Do you make any preparation to save it and bring it into a reclaiming plant? All packing removed from the boxes is put into a bucket, whether out on the line or in the shop. We have a form submitted each month. If we send to the station 600 lb. of packing, the report the first of the month shows that on one side and we show the amount of material disbursed or delivered. We have a column on the opposite side that shows the amount received and if we do not get back at least 75 per cent of the amount that we send out, we immediately get on the job and find out why.

A Member: How do you arrive at the average mileage per hot box? I understood one man to say they got 31,000 miles per hot box. How do you get the data from the various divisions and how are the reports made? What are hot boxes, when they are smoking or when they are blazing?

M. J. O'Connor: This performance record was based on any car that was rebrassed or repacked, whether it caused a detention of the train on arrival at the terminal or not. If we have to base that on failures, our performance would be nearly 60,000 miles.

B. F. Patram: There was a lively discussion at the A. R. A. convention about using a plug of waste in front of the journal or having it just packed flush with the end of the journal.

M. J. O'Connor: The standard practice on the railroad I am connected with is to leave out the so called plug. There has been a lot of agitation about the front plug. One fellow says if you do not put the plug in the front, you cannot keep the packing in behind the journal. The proper method is to place the roll in the back of the box and work it up evenly so that you do not have it up on one side more than on the other. It is there better to exclude the dirt. It is a very important thing and it is a hard matter to maintain when you have trouble out on the road. The proper method is to pack boxes so that there is a continuous feeding of the packing, so that when it is in, it is practically all in one piece. If it is put in properly, the only lateral play you will have, is the distance between the end of the journal bearing and the inside face of the journal. If it does extend out a little, after the car has gone over the division and shows indication at the next terminal point of working out, the car oiler, or whoever is looking after the journal boxes, knows that. If you have a plug in front, he does not know it. The only indication you have is when the collar of the journal has worked out into the packing. I know it will not work out sufficiently to cause any trouble. When we began the method of packing boxes by eliminating the front plug, we started it out on the very best trains.

T. J. O'Donnell: Do you feel that a practical lubrication man riding the trains is an advantage?

M. J. O'Connor: Absolutely. We are going to get more cars over the road with less cut-offs. It was really a matter of education to the men. If something happened and the car man was not at fault they might try to blame him just the same. In traveling around the very fact that you recognize his little complaints increases the co-operation. A man out on the road is of great benefit to the department, if nothing more or less than in the matter of education.

T. S. Cheadle: As I understand you pack without a front plug. When a car comes to you with a front plug in there, do you take it out?

M. J. O'Connor: No, not unless we change the wheels or bearings.

T. S. Cheadle: Lack of uniformity is giving us considerable trouble. The inspector cannot tell whether it is there for the purpose of forming a front plug. I do not think we can get much improvement until we have a uniform practice. I believe a letter ballot should be taken.

A Member: What system have you for treating hot boxes when delivered in interchange? At the point of interchange do you take care of the boxes immediately, or do you allow them to cool off?

M. J. O'Connor: The cars received in interchange are marked to the repair track. It is our practice in the terminals not to allow the men to use their own judgment.

C. E. LaMontagne (Rutland): We ran into quite an epidemic of cut journals at one of our interchange points in connection with your road, and I think the matter can be overcome if these boxes are treated, and a little oil or new waste applied to keep the journals from cutting, which is very expensive.

M. J. O'Connor: It is my opinion that where a journal becomes hot to the extent of blazing, there is no question about its being cut. Some roads cool it and pack it and hand it on to the other fellow. Let the man get that car in its original condition.

A. Kipp (N. Y. O. & W.): I understand Mr. O'Connor to say that they have two systems on the N. Y. C. of treating boxes: If a car comes in that had a plug in it, they put in a plug; if they didn't have a plug, they packed it without a plug. Do I understand correctly?

M. J. O'Connor: No. The question was: "Do we remove the plugs?" and I said "No." But if we change the wheels on a car or rebrass a car, we will not put the plug back in there.

C. E. LaMontagne: If a car delivered into a train from one connection to another has a hot box, don't you think that the box ought to get immediate attention?

T. J. O'Donnell: If we deliver 50 cars across the dead line to the delivering line and there is a car blazing, the car will be on the repair track in an hour and a half. That is the attention we give it.

C. E. LaMontagne: The point I was getting at is not to have the cars switching around.

T. J. O'Donnell: In our district it is all receiving line inspection.

C. E. LaMontagne: Couldn't a lot of these cut journals be eliminated if the boxes were taken care of at the time of delivery?

M. J. O'Connor: No, for the reason that the movement does not amount to anything. That condition exists when the car moves in the terminal.

G. Lynch: I would like to ask Mr. O'Connor if there is any attempt at uniformity of practice in packing boxes, and what he would propose as the best method.

M. J. O'Connor: There are representatives here of a few railroads that are packing boxes along the line that is standard with the New York Central. I think I outlined the method they considered proper; that is, placing the roll in the back of the box and feeding the packing in, not rolling it on the side. Some do not put any roll in the back at all. Then the box packer reaches down in a bucket and takes a handful and shoves that back, and he keeps on until he has the box packed in sections. The result is, if you have any lateral, which you have in most all boxes, the piece becomes dislodged and twists the next piece, and so on. How many

men here have seen where lids were forced open? If it is packed in in a continuous strand, knitted together, you will never have that condition. That is a hard thing to accomplish. I am after that day after day, particularly when we put on new men. That is the first thing I look for. It is my duty to instruct them. In that way we have uniformity, and everybody in the car department, from the superintendent down to the doper, takes an interest in it.

G. Lynch: The important question is to get uniformity of practice on all railroads. I find there is nothing but individual practice, and I wonder if it would not be practicable to incorporate a rule in the book of rules, making it compulsory to pack in a certain way, whichever way it is decided best. I think your paper is very fine and your explanations good, but we have no uniform practice on the railroads. All of the railroads in the A. R. A. should get together and adopt some method.

M. J. O'Connor: That is one of the things I hoped somebody would talk about; that is the principal thing to do, and the other is a method of reclaiming journal box packing. The railroad I am connected with has spent thousands of dollars installing reclamation plants at central points to cover certain territories. The reclamation of packing answers two purposes. In the first place if a man reports to his general foreman "We repacked 90 cars last month, periodical packing and stencil," you will use in packing 90 cars, about 9,000 lb. of material, it runs about 100 lb. per car. If that man hasn't used 9,000 lb. of that material, you then know that some of that material removed was not sent in to be reclaimed. It is a check on the work and it also insures better service.

Mr. O'Donnell said on arrival in the terminal that an inspection was made for safety appliances. The car would then go possibly 15 miles to a receiving line, and it would then be given an inspection. On a car coming in with a box smoking pretty badly, the journal bearing ought to be changed if it must be done, in four or five hours. It is cool and may run over fifteen miles, but when it gets on the main line, the journal will be cut.

T. J. O'Donnell: You might just as well stop every 15 miles on a 100 mile division and poke your hook in the box. If the box is blazing, we will get it on the delivering line. What is the use of holding the train up?

A Member: The car doesn't have to be blazing to have a cut journal in the terminal before it is delivered to the connecting line.

T. J. O'Donnell: You do not see a blazing car going across a dead line once in two weeks. If you have a meat car it will be shipped across to the other fellow.

A Member: Is the use of free oil entirely eliminated on the New York Central or have the men access to it at certain interchange lines where you receive high class freight? Do you allow the use of oil at points where they receive meat cars in interchange? What method is used in taking care of these boxes?

M. J. O'Connor: We do not use any free oil on freight cars. The last place that was used was at Sixty-third street in Chicago.

T. S. Cheadle: Is it the fault of lubrication or the fault of the mechanical conditions of the brake that causes hot boxes?

M. J. O'Connor: Quite a percentage of hot boxes are due to mechanical defects. Some roads apply journals with white lead on them. One of the worst conditions is the hollow journal bearing wedge. We destroy thousands of these hollow back wedges when we find them worn flat. Wedges are supposed to have 1/16 in. crown at the top. The function it performs is to distribute the load evenly to the bearing. If some of the other railroads will get after it as we have, we will have less hot boxes.

G. Lynch: When a wedge is worn, do you have it replaced with a new wedge?

M. J. O'Connor: Yes, or a good second hand one.

G. Lynch: We have found that where the wedge is worn, and a new wedge applied, before the car runs 20 miles, that new wedge is often broken because of the uneven bearing, due to the worn condition of the box. Under such conditions the box should be examined to see what condition the roof is in and if worn badly, the box should also be removed and a new one applied with the new wedge.

M. J. O'Connor: The boxes that you have reference to have had a wedge in with four pockets, some with two pockets, and instead of having 1/16 in. crown spread over the entire radius of the wedge, you have only that little bar. That is what wears the roof of the box. Where a solid wedge with a steel back is used I have never yet found them broken. Our standard is the solid back wedge and has been for three years.

A Member: Does the New York Central line confine the use of reclaimed packing entirely to its own cars? In repacking passenger cars do you use reclaimed packing?

M. J. O'Connor: Reclaimed packing is used on passenger cars the same as on freight. We found out when we had a high grade wool waste, it would not hold oil in suspension, particularly if the strands were more than 14 or 18 in. in length. With new waste, heat is required to saturate the oil.

A. J. Baumbush (N. Y. C.): At Grand Central Terminal we noticed that all of the boxes that were packed with new long wool waste were running hot. We tried using half cotton and half wool waste and found the journals ran cool. We are taking half wool and half cotton now, the majority new waste mixed in with the old. Our hot box trouble at Grand Central Terminal is almost gone. We do experience some hot box trouble when we do not catch them in time. The majority of the trouble is with cracked linings.

It is important for the car packer to use a knife on both sides of the box to crowd the loose ends down because when the brakes are applied, the journal picks up the loose ends. I guarantee if you leave the front plug out and the journal is all right, you will not have any hot boxes.

Mr. Clair: I have spent the last seven years to determine the best method of lubricating journals. I visited the railway waste plants throughout the country, with a view to getting journal box packing up to specifications. Unfortunately, it is a fact that the personal element enters into it and we have never been able to get a standard journal box packing. An honest endeavor was made to standardize the journal box packing. The problem was whether it would be cotton or wool or a mixture of both, which meant that some grades should be eliminated—these things which enter into journal box packing under the guise of waste materials.

Cotton and wool are considered to be the essential elements that might enter into the thread and yet there are many railroads calling for one hundred per cent wool and material is being accepted when there isn't one atom of wool in it. Often in treating waste to find out how much wool there is in it, everything in the shape of animal matter is credited as wool. There are some specifications which call for all wool waste long threaded stock. The threads might have been two miles in length if they were spun for journal box packing. It is bought for wool but it is cattle hair and steer hair, with nothing to bind the materials together except fuel oil. The hair that comes off of the back of sheep runs in lengths from two to ten inches and that is what you want in journal box packing. You do not want long threads, but you do need long staples. Sheep wool is covered with minute scales, similar to the back of a fish. When they are spun together they form a thread and if you take the thread and endeavor to separate it, you will find that it holds together. If you take the so-called red yarn and pull it apart, you will find the

staples in the spinning similar to that spun with fuel oil which is worth two cents a pound for journal box packing.

The journal box packing should be cotton or wool, or something mixed together; it should be certain grades of cotton and certain grades of wool; not all good but there should be nothing put in there that was not calculated to lubricate the journal. We refused muck yarn, but after it was dyed red and filled with mineral matter it was accepted. The reason that the long threads of wool did not function in our boxes, is that they were not wool and were filled with a mineral dye to make them look better. Two years and a half ago, we got 200,000 lb. of cotton, and found that it had been loaded with water glass or sodium silicate. The staples are bound together with starch in order to weave sheets. When potatoes rose in price, water glass was substituted and that was the material that was entering into practically all journal box packing.

It is well to understand the journal box packing that you are getting. Some of the waste industries are nothing more than rag industries. There is one concern that takes old felt hats and that refuse goes into journal box packing. Until the United States Railroad Administration undertook to define these particular things which should not enter into journal box packing, they tried to eliminate them by stating that packing should be true fleece wool. Leave it up to your inspectors to go into the mill and analyze the material to see that it is true fleece wool. Material that comes in such long threads is not waste material. It is hair taken off the backs of cattle and spun for journal box packing. If you take the oil out of it, you will find it is a decidedly choppy mass of hair.

It is necessary to take such materials as can be produced in quantities. A proper source of material would be mills that weave overcoats, blankets, carpets and some tapestry. A source of materials for the cotton should be confined strictly to mills that produce shirting and some of the high grade linens. The cheap American cotton cannot be produced without putting potato starch in. Avoid the use of jute absolutely and specifically. The cheap grades of carpet are made out of jute and when treated it rots and becomes a powder. The shredded stock is used in order to cheapen it and it is well to get away from it.

I believe the day is not long distant when each and every railroad will honestly say to itself, "When we buy cheap materials for journal box packing, it would be better if we would adopt some standard, all good wool or all good cotton. Let it remain a waste problem but let everyone for once and all decide what it is which constitutes a standard journal box packing."

There are some roads that pay 30 cents a pound for journal box packing; it is not worth it. The cotton that enters into an honest journal box packing is worth 14 cents a pound, and when material sells for 10 cents, you will find that it is sweepings. That was my experience after having made a study of what honestly would constitute journal box packing of good quality that might be produced in a tremendous volume and uniform quality.

Mr. Geiser made some good tests. They were able to calculate how much oil was necessary to lubricate a journal, and it only took 5 per cent of the oil that was in the waste. We were looking for a journal box that would hold four pounds of oil per packing; it was too much. There are those who say the use of free oil is improper. They think they save money by not using oil and they do not think they pay 15 or 10 cents for the waste and burn it up without securing lubrication.

Reclaiming pays but not the reclamation that necessitates the erection of a $10,000 building with its equipment. But the conservation of waste material when you take out good journal box packing that is not all choppy, and shake the dirt out of it, if there is any in it, saturate in oil and put it back into the box is a good thing. But in the reclamation that necessitates some one saving it, it does not pay. If it is good waste it is fit to go back into the box. If it is bad waste, it ought to be destroyed right there. There is lots of money wasted by saving bad waste. Today waste is billed in accordance with the specifications that the threads should be clean, long, strong, true fleece wool. Other specifications say it must be long strands, none shorter than 18 in. in length. Good wool comes from mills and is honest waste material. The stuff that is long is not waste. It is spun for journal boxes; it looks good but you will find it is not at all satisfactory.

Another peculiar thing is that wool is necessary. Wool does not lubricate; it is cotton that lubricates, but it has to be good cotton. If it is foreign it is better. The test of the thread that enters into a journal box packing should be its fineness. When the staples are long you can spin the thread as fine as a needle and that is good. When the thread is thick the staples are short, and that is bad material. It is true of cotton, a thread spun 120 will not measure over 0.003 in. in diameter, but it is good cotton. The test of high quality is not length; if other things are equal, it is thinness of thread.

Another thing that serves no function is the flyings. There is no reason why anybody should take anything that looks like feathers and mix it in a journal box. If your specifications insist on cheap material, you have got to go to the cotton mills and buy the sweepings from the floor for 3½ cents a pound and introduce it into the journal box packing in order to sell it. It will require 2½ lb. for a journal box of 3½ cent cotton. It is cheaper to use the cotton than wool. Your journal box packing costs 15 cents and the lubricating oil is worth about 2 cents, and if you are not careful you will get 10 per cent lubricating packing; you do not get packing, you get oil. Look out for the waste that is saturated with oil. The functions of the journal box packing are first to hold the oil and then to feed it.

Cotton and wool combined do not afford elasticity to overcome the shocks and keep it up against the journal; you have got to impart some elasticity.

The best method of packing journal boxes in my mind is twist a rope and put it back against the mud guard, and put the biggest wad of packing that you can get in that box; take these threads and fold them over and under and put one piece of journal box packing in the box. The use of the plug is a disputable thing. If there is no plug in the front, the face of the journal will present one thing in vision; if the box is running hot the center of the journal will be dry. If there is a plug there you won't see whether the journal is running hot or not. Whether it is a good thing to offset your lateral motion, I do not know.

Avoid the use of what you call wipers. A piece of waste as big as an egg will wipe the oil off before the oil hits the brass. One little piece of waste improperly placed in that box will give trouble. Keep the little pieces of waste buried down; do not let them get on top of the journal box or there will be trouble.

F. W. Trapnell: This is a subject that has brought out a lot of discussion before in the A. R. A. convention, but I believe that those of us who are here have received more benefit from the discussion relative to the maintenance and packing of journal boxes that we ever got at Mechanical Section No. 3, because we have got right down to the ground floor of the work, as it ought to be done.

I am sure it is a pleasure to listen to Mr. Clair and to the reading of the paper by Mr. O'Connor. They have made it very plain and explicit to us. I move that a vote of thanks be extended to Mr. O'Connor and to Mr. Clair. (Seconded and carried.)

Belt Service and Length of Life

BY F. D. RICH

Sales Engineer, Crescent Belt Fastener Co., New York

Cutting the ends of a belt seems such a simple operation that often the belt man does not give it the consideration necessary to secure the best results, and much of the difficulty with otherwise good belts is due to their not being cut and joined accurately. With proper care, it is easy to make a belt joint which will run the same as an endless belt.

When a belt runs "wobbly" or races back and forth across

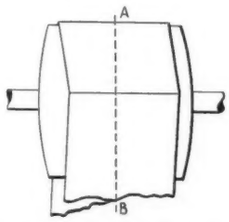


Fig. 1—A Belt Which Will Not Run True

the pulleys, it is not giving its best service nor can it have a long life. Power is lost and production limited.

Belt ends should always be cut to a line carefully laid out with a square. If a square is not used, one or both ends of the belt will be cut unevenly or irregularly, which prevents smooth running. Even the use of a straight edge does not assure the results obtained by using a square, for the slip of a fraction of an inch will bring the belt ends together at an angle, as shown in Fig. 1. As the belt moves from side to side, the line of direct pull, *A-B*, moves from one side of the belt to the other, imposing shifting and irregular strains, which no belt can stand indefinitely.

There is only one way to obtain correct results, which is to use a belt square and to keep it in place until the belt is cut all the way through. Cutting to the square assures an even cut all the way through the belt and all the way across. Then the belt ends can be brought together in a tight, but evenly running, flush joint. For belts up to 15 or 18 in. wide, the ordinary square can be used, pressed firmly against the edge of the belt with the knife held vertically. The knife should be sharp with the point wet occasionally in order to cut more easily. When a number of belts have to be cut, a good method is to drive two nails in a large block of wood, and against these set the edge of the belt and the edge of the square. This prevents either the belt or the square slipping.

Wide belts are more difficult to square correctly, and the difficulty is often increased by slight variations in width, which throws the square out. To avoid this and assure perfect results, the method illustrated in Fig. 2 has proved valuable. At any point near where the belt is to be cut, measure across and find the center, as at *A-A*. At any distance back of this, say, 2 or 3 ft., find the center again, as at *B-B*. Between the two center points draw a clean, sharp line, marking the center axis of the belt. Using the square against the center line, trim off the end of the belt, holding the square firmly in position. Two small nails driven in the center line will keep the square from slipping.

For cutting the other end of the belt, find the center line, as just described. At any point on this line other than where the belt clamps will come, take a point *C*, as in Fig. 2, and, using the square as illustrated, draw a line *D-C-B* at right angles to the axis, and all the way across from edge to edge. It is sometimes easier to draw this line by marking the points *D* and *B* and then placing a straight edge through the points *D-C-B* to draw the line. This line *D-C-B* will constitute a "base line" to measure from after the belt is in the clamps. Do not cut on this line.

The exact position where the belt is to be cut can be determined after the clamps have been put on and the belt brought into position. Measure forward from the line *D-B* an equal distance on each side of the belt to the cutting point, using calipers to measure over the belt clamp or running the ruler through the edges of the clamp. As a matter of convenience, always cut one end of the belt square and get it ready for making the joint before putting the belt into the clamp.

Remember that when doing a job, it is much easier to do

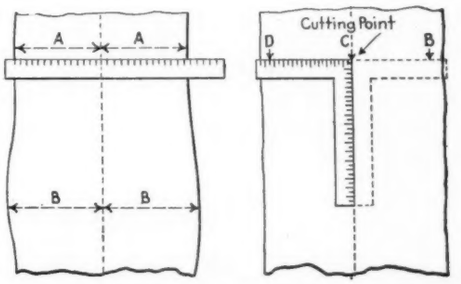


Fig. 2—Method of Squaring Uneven Belt

it right than to do it over. This applies to making the completed joint as well as to cutting the belt. Therefore, it is best when joining a belt to do so in a way which is permanent and which assures the belt's most satisfactory service.

The writer has had considerable experience working with belting manufacturers in solving the problems of efficient belt joining, and is much opposed to methods which require punched holes in the belt or which in any way cut or weaken the lengthwise, power-carrying fibres of the belt. No belt can give better service than its method of joining will permit, and if wasteful or destructive means are employed, the strength of the belt is lessened, its service impaired and its

life shortened. Laced belts are frequently found in which from 40 per cent to 70 per cent of the cross section of the belt is removed in punched holes. Such a belt joint cannot be expected to give the full service of the belt.

The ideal belt joint is one which would run the same as endless without the drawbacks of difficulty in making and later shortening to take up stretch. Belting manufacturers themselves estimate that only a small percentage of belts need to be made actually endless. Their estimates range from ½ of one per cent to two per cent. It is possible to make belt joints which run the same as an endless belt and which meet

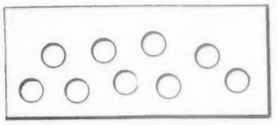


Fig. 3—Aggregate Amount Punched Out Is 75 Per Cent of Total Cross Section

practically all requirements of the belting field, without having any of the objections noted above.

The accompanying list shows the qualifications of a belt joint, by which any engineer can check up the comparative efficiency of his own methods:

THE EFFICIENT BELT JOINT

1—Will maintain the maximum strength of the belt.
2—Will avoid destruction or weakening of the lengthwise power-carrying belt fibres.
3—Should prevent breaking the belt back of the joint.
4—Must not hammer on the pulleys.
5—Must not be subject to wear or crystalization.
6—Will insure continuous, uninterrupted operation without supervision.
7—Hugs the pulleys tightly and assures full transmission of power.
8—Runs silently, the same as an endless belt.
9—Can be easily taken apart for removing or shortening the belt.
10—Is safe against accidents or breakdowns.
11—Must be easily and quickly made without special equipment.
12—Will last for the life of the belt.

The leading manufacturers of belt fasteners are always willing to give engineers full data regarding their products, and a check of the different methods against the qualifications above should enable any engineer to determine for himself which is going to assure getting the most satisfactory results and service from belting.

Limitations of Thermit Welding for Repairing Cast Iron

In a recent issue of Reactions the following explanation regarding the conditions governing the welding of cast iron by means of thermit is given:

In thermit welding, the superheated steel produced by the reaction, when tapped into the mold surrounding the weld, naturally fuses back into the fractured parts two or three inches on either side and the whole mass solidifying at one time effects the repair. The excess metal of the weld may then be removed or not as the necessity indicates.

In cast iron welding, steel is the welding medium and the weld material will, therefore, necessarily consist of a mixture of this steel and the cast iron of the parts being welded. The graphitic carbon in the cast iron, therefore, combines with the thermit steel, thus making a high carbon steel which usually can be machined only by grinding. This material, however, is not so brittle as cast iron and is physically stronger.

In the second place, in considering thermit repairs of cast iron, it should be borne in mind that the weld material is steel and, therefore, has double the shrinkage of the cast iron. This difference in shrinkage is of no importance where the section being welded is approximately square or equiaxed. However, where the length of the section at the fracture is four or five times its thickness, this difference in shrinkage is evidenced by one or more minute cracks perpendicular to the line of the weld and extending through the weld material only. These cracks are naturally caused by the difference in shrinkage, the cast iron parts tending to restrict the shrinkage of the thermit steel along the length of the piece. Such hairline cracks will be found in the welding of sections such as, for instance, 12 in. by 24 in., but would not be found in sections 12 in. by 12 in. The cracks are unimportant, as they are parallel to the line of strain.

Experience proves conclusively that where the length of a fracture is not more than four or five times its thickness and where the subsequent machining can be accomplished by grinding, a thermit weld can be made with entire success.

The Equalization of Spring Rigging

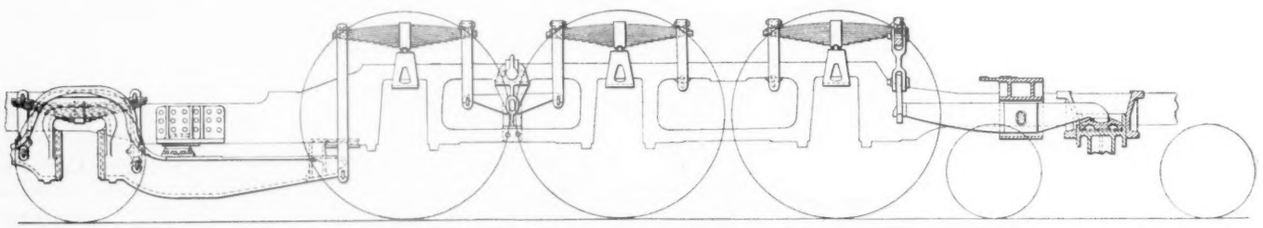
BY J. McALLISTER

General Foreman, West Albany Shops, New York Central

Because the springs and spring rigging used on a locomotive cannot be classed as motion work, there is a strong tendency to underestimate its importance and become careless in making necessary repairs and maintaining the dimensions called for by the blue prints. The improper equalization of springs and spring rigging has very serious effects, the most important of which, perhaps, is the resultant incorrect distribution of weight. This causes excessive pressure on certain bearings, which means that they will run hot and require new brasses frequently.

Hot bearings necessitate frequent repacking and oiling of boxes, wasting a large amount of oil. They also cause many engine failures and many stops to cool the boxes and repack the cellars. In more serious cases where the cutting action has gone on too long, new brasses must be applied to the driving boxes and the cut journals turned. In addition, hot bearings tend to make indifferent engine and train crews on account of the extra disagreeable work necessitated by cooling and repacking the boxes.

Improper spring equalization is caused by poor methods of repairing and assembling spring rigging. It is the usual practice to repair spring hangers to standard sizes. When a locomotive is being broken in, it is usually found too low and must be returned to the shop to be raised. This operation is performed by jacking up the locomotive, shortening a hanger here and there, putting a liner in the center casting, etc. This, of course, results in all idea of equalization being lost and puts excessive weight on one or more of the bear-



Elevation Showing Arrangement of Spring Rigging On Pacific Type Locomotive

ings, causing them to run hot, which brings about the evils previously enumerated.

The very best engineering talent is employed in designing locomotives and it should be the aim when repairing them to perpetuate the designer's idea of the locomotive as a whole. To do this it is necessary to equalize springs by shortening the hangers to correspond with tire wear, for example:

The original thickness of the tire is 3½ in. and all parts of the spring rigging are made to blue print sizes. If the locomotive is shopped and the tires turned to 3 in. all spring hangers should be sent to the blacksmith shop and shortened ½ in. A ½-in. liner in the engine truck center casting and a ½-in. liner under the trailing springs will bring the locomotive to its original level.

It is well for the gang foreman to examine and measure the thickness of crown brasses before putting wheels under a locomotive. If one brass is found ⅛ in., for example, thinner than the other, a suitable liner should be placed under the spring saddle of that box. When spring rigging repairs are handled in this way, the designer's idea of equalization is maintained and hot bearings, with their attendant evils, are reduced to a minimum.

Standard Valve Motion Pins and Bushings

A Method of Standardizing, Manufacturing and Fitting Pins and Bushings in Locomotive Valve Gears

BY M. H. WILLIAMS

IN certain central production shops of the larger railways, valve motion pins and bushings required for locomotive valve gear repairs are blanked out and finished to predetermined grade sizes. Surfaces, like the straight part of the pin and the bore of the bushing, are finished complete at the time of manufacture and do not require additional machining when being fitted to the levers. The taper ends of pins and the outer surfaces of bushings are made sufficiently large to admit of machining to such sizes as may be necessary to fit worn levers.

Important results have been made possible by a careful study of the requirements and standardization of the bearing

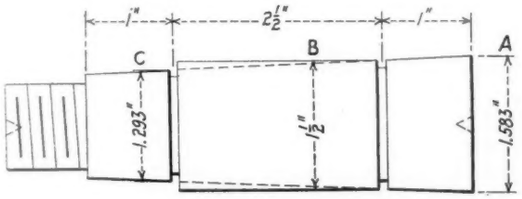


Fig. 1—Standard Pin With Taper of 1-In. per Foot

surfaces in reference to each other so that they are interchangeable. For cases where the lever holes are greatly worn, the running fits also are standardized to grade sizes. That is, if the original size of the running fit of these pins and bushings is 1½ in., grade sizes are made 1 9/16 in., 1⅝ in., etc., or such sizes as may be necessary.

Standardization of Parts

On account of the many sizes of holes resulting from frequent reaming of the lever clevises, it is not generally considered desirable to make the taper ends of pins to finished sizes, but rather to blank them out, leaving sufficient metal for fitting at the time of application. In some cases the taper ends also are finished to grade sizes and both of these methods will be explained later.

With most designs of pins, especially where the taper is more than ¾ in. per foot, it is possible to increase the diameter of the taper ends somewhat more than called for on the locomotive drawings without encroaching on the straight surfaces. Where the rod clevises are greatly worn, however, it becomes necessary to enlarge the bearing surface and the bore size of the companion bushing which is done to grade sizes.

Grade sizes are determined in the following manner for the pin illustrated in Fig. 1. The ends have a taper of 1 in. per foot, the bearing surface *B*, being 1½ in. in diameter by 2½ in. long. The two ends are each 1 in. long. The size of the large end at *A* is shown as small as it may be made: 1.583 in. The diameter of the opposite end at *C* must correspondingly be 1.293 in. which agrees with the 1 in. per foot taper as shown by dotted lines. A pin made to these dimensions can be used in a bushing having a 1½ in. bore and admit of finishing the full length of the taper surfaces. If the tapers are smaller, the beginning of the large taper will be smaller than the bearing surface.

A pin of the greatest extreme of taper end sizes with the same bearing surface *B* is shown in Fig. 2. The small taper at *C* equals the 1½ in. bearing size. The head is shown enlarged to 1.790 in., which is the largest that may be used with a 1½ in. bushing. It is evident that to go to a larger taper end will result in not having a full taper end at *C*. Figs. 1 and 2 show the smallest and largest taper ends that can be used with a taper of 1 in. per foot in a 1½ in. bushing, 2½ in. long. The diameters of the taper ends and the grade sizes are calculated as follows: The taper per inch is obtained by dividing the taper per foot by 12 and is 0.083 in. This figure multiplied by the length gives the variation for any length or section of the pin. Likewise the taper per inch multiplied by the length of the bearing surface *B* will indicate

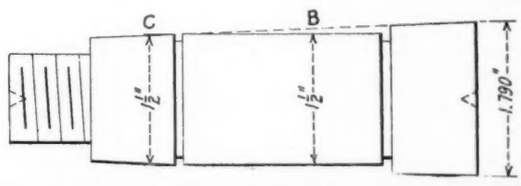


Fig. 2—Standard Pin With Greatest Extreme of Taper End Sizes

the greatest difference in diameter possible between grade sizes. In Fig. 1, the diameter at *A* is the bearing size of 1½ in. plus the taper for 1 in. length, or 1½ in. + 0.083 in. = 1.583 in. In Fig. 2, the diameter at *A* is the taper calculated from the 1½ in. diameter at *C* which is 3½ × 0.083 in. + 1.500 in. = 1.790 in. These calculations are necessary in order to settle on the largest diameters to which the head end at *B* should be blanked out.

The maximum increase of grade sizes for pins having a bearing surface 2½ in. long will be 2½ × 0.083 in. = 0.207

in. It is evident that the second grade size of *B* can be 1.707 in.; the third 1.914 in., etc. From simple calculations of this nature grade sizes for any size and taper may be quickly calculated.

As a general proposition, the grade sizes of bearing surfaces *B* are calculated and tabulated or card indexed for all pins frequently used. One large shop advances the grade sizes by 1/16 in., that is, the pin bearing surfaces are made standard, 1/16 in. and ⅛ in. larger than standard which works out in a very satisfactory manner. The objection to too large an advance in grade sizes is the enlargement of the bushing bore which results in a thinner wall of that member.

Having determined the grade sizes, it is next necessary to set tolerances for bearing surfaces and the bore of bushings. There should be between 0.004 in. and 0.006 in. play between the pin and bushing when the two are in place, in order to allow for a running fit and flow of the oil. When pressing the bushing into the lever, the bore will be reduced about 0.002 in. to 0.004 in. depending on the thickness of the wall and the care with which the fit is made. Therefore, the bushing bore should be made about 0.008 in. larger than the pin.

When manufacturing, the taper ends are preferably blanked out as shown in Fig. 2 with the larger end of the smaller taper shown at *C*, equal in diameter to bearing surface *B*, the large end being the taper extended from *C* as determined by calculation and shown by dotted lines. From a manufacturing standpoint, it is an advantage where the sizes are standardized as the number of sizes will be reduced, consequently, the number of one size called for at one time will be increased to the point where they can profitably be made on automatic screw machines or turret lathes.

Blanking Out and Finishing Pins

No attempt will be made to explain, except in a general way, the machine operations employed when blanking out pins and bushings. They are generally made from hot rolled low carbon or screw machine stock, or some soft steel that is free turning and free threading. When manufacturing, the taper ends are rough machined to the approximate size, the threaded portion made to correct size and the holes for lathe centers drilled in the ends. In some cases a groove is made at each end of the bearing surface next to the tapers for

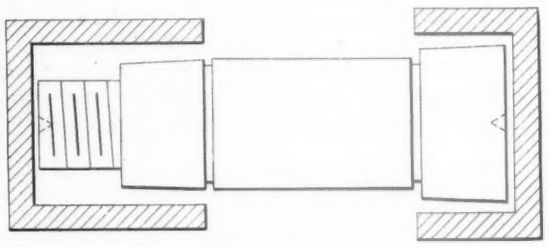


Fig. 3—Method of Protecting Ends When Case Hardening

clearance when grinding as shown in Figs. 1 and 2. The bearing surface that should be close to gage is machined about 0.020 in. large to admit of final finishing, as will be explained later. The threads are cut on a bolt threader, or in some cases this threading is done when blanking out. Holes for cotter keys or taper pins and spline keys are drilled with a drilling jig. The pins are in some cases used in a soft state with brass bushings. Where this is the practice, they are ground on the bearing surface *B* to the exact micrometer or gage sizes for which a limit is set that should not be more than 0.001 in. above or below the nominal size.

Where pins are to be casehardened, it has been found good practice after blanking out to grind the bearing surface *B* previous to hardening about 0.010 in. larger than the final size required. This is done in order to true up this surface and correct errors resulting from the lathe centers not being true and to remove roughness left when blanking out.

The pins are now ready for casehardening, an operation governed by the machines available in shops where the pins are to be finally fitted to the levers. If grinding machines have been installed, the pins are casehardened all over except the threaded portion which is protected by covering with fire clay. If grinding machines have not been installed, one of two plans mentioned below is followed. First, the pins are carburized only. That is, the threaded end is protected

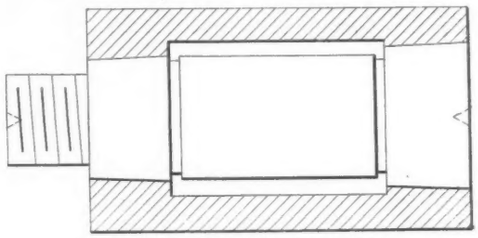


Fig. 4—Female Gage for Taper Ends

as explained above, placed in the casehardening box and heated in the usual manner. When removed from the furnace the box and contents are allowed to cool and anneal. This results in a soft high carbon surface that may be machined when fitting to levers similar to annealed tool steel and may be turned as desired. Second, the threaded ends and also both taper ends may be covered with fire clay held in place by cast iron cups or gas pipe as shown in Fig. 3. Pins, cups and fire clay are then placed in the casehardening box, heated and quenched in the usual manner. This results in hard bearing surfaces and soft taper ends, and as a result the ends may be turned when fitting to the levers.

The bearing surfaces of pins that have been casehardened or carburized only are then returned to the central shop and ground on the bearing surface to exact gage sizes as explained in connection with soft pins. In some cases, this practice is modified by grinding the taper ends to grade sizes that may vary by 1/64 in., 1/32 in., etc., the ends being carefully fitted to taper female gages as shown in Fig. 4. After completion by either of these methods, the pins are placed in stock.

Blanking Out Bushings and Fitting to Rods

Bushings are made from the same material as the pins, in automatic screw machines, the holes being drilled and reamed about 0.010 in. small to allow for final grinding. The outside is rough machined to such sizes as may have been set when standardizing these parts. The oil holes are drilled and the oil ways milled, after which they are casehardened or carburized by one of the methods that have been explained for hardening pins. The bore is ground to plug gage sizes that should not vary more than 0.001 in. from set sizes. The diameter of bore at this grinding is made 0.008 in. larger than the pin bearing size. If grinding machines are not available for machining the outside of the bushings, they are carburized as explained in connection with pins, the bore being ground to gage size and placed in stock.

A flat gage, as shown in Fig. 5, has proved very useful for checking the accuracy of the taper reaming of clevises and also for measuring the diameter of holes at any point. The gage is made of hardened steel about ¼ in. thick, the

edges fitting the taper holes being ground on centers similar to the practice when grinding cylindrical gages. One side of the gage is graduated, each line marked with figures indicating the exact diameter at that point.

Pins and bushings made as above explained in the central production shop are finished on the bearing surfaces and the final work is confined to machining the taper ends of pins and the outsides of bushings. When measuring the diameter of clevis taper holes, the graduation nearest the inside of the smaller jaw is usually read. This point is chosen because it is desirable that the shoulder on a taper pin shall stand away a small amount from the clevis to allow for drawing up when wear takes place. Also in the event of the width of clevises not being correct, the error will not affect the fitting of the pin at this point. Should the hole be irregular, the gage will show the error, in which event, the lever is reamed just enough to true up or to reduce to gage sizes according to the method used when fitting the pins.

Grinding Taper Ends

By the use of suitable cylindrical grinding machines, the taper ends of pins are ground to fit the different sized holes found in repaired levers in from 10 to 15 minutes. The pins while being ground are driven from the threaded end, a method which admits of finishing both ends without reversing the pin in the machine. The machine table is set to the correct taper after one or more trials, and when once set, any number of pins of the same taper may be ground without resetting.

The exact diameter in thousandths required is read from the taper gage as shown in Fig. 5. In order that the pin

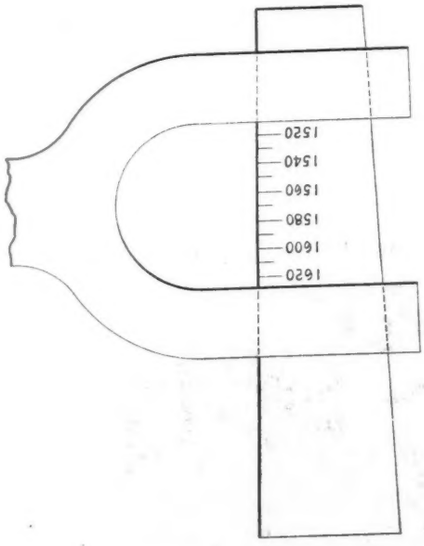


Fig. 5—Flat Gage for Checking Accuracy of Taper Reaming

shall fit properly, the diameter of the taper at that point must be the same as indicated on the gage. When grinding, the pin is measured over the taper as shown at *C*, Fig. 6, with micrometer calipers and finished to a size agreeing with that read on the gage. This measurement is readily made where a groove has been made in the pin as shown.

When the smaller taper has been ground to the proper size, the micrometer-dial or throw-out on the grinding machine governing the in-feed of the grinding wheel is set. The wheel is then transferred to the large taper end and the wheel fed in to the same marking or setting of the throw-out stop used for the small end. This results in the two ends having the same taper and the pin will generally fit the lever at the first trial. Errors may result from the spring of the machine, or the personal equation, but with an operator who has had practice, about 75 per cent of the pins will fit at the first trial. The grinding machine should be one of the larger sizes and have the necessary weight and stiffness in order that the grinding wheel shall not spring away from the work when grinding the two ends.

A grinding wheel as thick as the length of the taper ends is fed directly onto the work and not traversed. Where the wheel is kept true by occasionally passing a diamond over the surface, this method has been found quicker than traversing the wheel.

Where soft pins are machined on lathes, the same general plan is followed. If the pins have had selective case-hardening, they will be completed in this operation and can be placed in service.

Where pins are carburized only, they are fitted in a similar

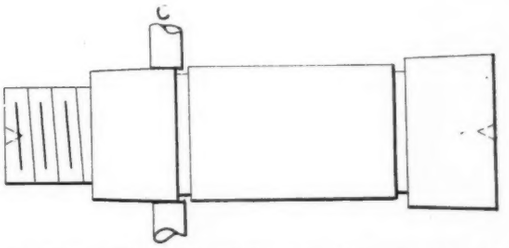


Fig. 6—Position of Micrometer Calipers in Measuring Largest Taper Diameter

manner and hardened, after which with a slight rubbing up of the bearing surface, they are ready for service.

In order that the bushings previously ground in the bore shall not be distorted when forced into levers, it is necessary that the lever holes be trued up by grinding on a planetary grinding machine such as that made by the Heald Machine Company or by reaming. The bushings are ground on the outside from 0.004 in. to 0.005 in. larger than lever holes and forced into place. Should it happen that the taper holes in clevises have been enlarged so that the smaller or new size pins and bushings will not answer, the next larger size is used.

Advantages of Grade Sizes

Making pins and bushings as above explained has certain advantages. It permits of manufacturing in larger quantities with the use of the most modern machines and methods at central production shops. On account of concentrating the grinding of bearing surfaces in one shop, this work can be done more economically and accurately. In repair shops, the fact that these parts are finished up to the point of grinding or turning the taper ends of pins and the outside of bushings is a great advantage. Also the fact that any pin will fit any bushing of the same class often makes it possible to change levers from one locomotive to another without fitting, a condition which is hard to attain unless these parts have been standardized.

COST OF TOOL BREAKAGE.—Convincing evidence of the high cost of tool breakage is afforded by the records of a Portland, Ore., factory. According to the Iron Age: "The records are a convincing testimony to the expense of putting good tools in the hands of careless or incompetent workmen. A charting of tool breakage shows that it is particularly heavy when numbers of new men are put to work. Damage to tools is a big problem, and careless men can destroy in a short time tools far in excess of their labors for weeks and months. But greater than the loss in money is the fact that it is in some cases almost impossible to replace at once many special high speed tools that are destroyed. Breakage of several important implements at about the same time compelled the plant to lay off a machine and hold up the entire progress of production."

The Management of a Locomotive Repair Shop*

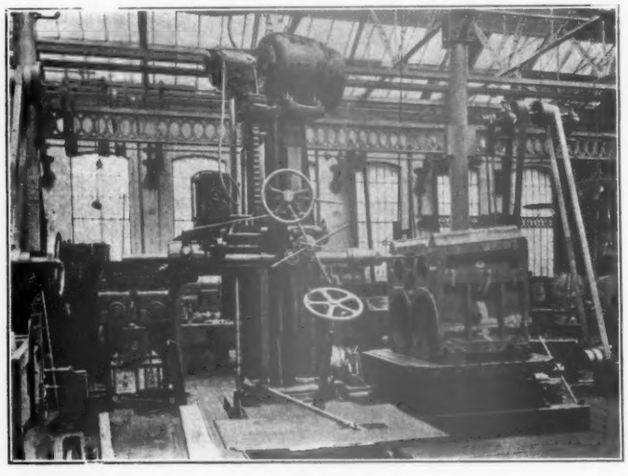
English Railway Practices; Modern Tools and Cost Records Necessary; The Repair Shop's Customer

BY COLONEL H. E. O'BRIEN, D. S. O.
Deputy Chief Mechanical Engineer, Lancashire & Yorkshire, Horwich, England

THE main objective of the management of a railway locomotive workshop is essentially different from that of a commercial manufacturing works; the engineering management of a commercial engineering works desire to see a constant expansion of their shops, while in the case of a railway management their desire should be to see a constant shrinkage of the shops brought about by:

(1) Improved methods of manufacture.
(2) Improved organization.
(3) Rectification of errors in design and material with the object of reducing renewals and repairs to a minimum.

It is possible to effect this because the capital expansion of the locomotive stock is very slow on English railways, and therefore the capacity of the works should more than keep pace with the demands if the management is progressive, in spite of the increased weight and power of the more modern stock. The number of locomotives on the Lancashire & Yorkshire has only increased from 1,326 to 1,645 in the last 20 years.



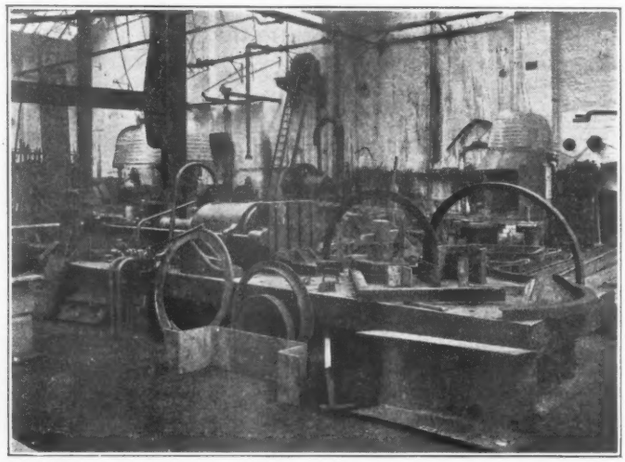
Asquith Horizontal Drilling, Milling and Tapping Machine Used With Eminent Success on Cylinders in the Horwich Shops

Modern Tools Should Be Installed on a Commercial Basis

While patient attention to methods of manufacture on existing machines will result in increased output, the best results will not be attained unless the most modern and most highly productive and specialized machinery is, on a commercial basis, applied to the work as rapidly as the machine tool manufacturers make it available.

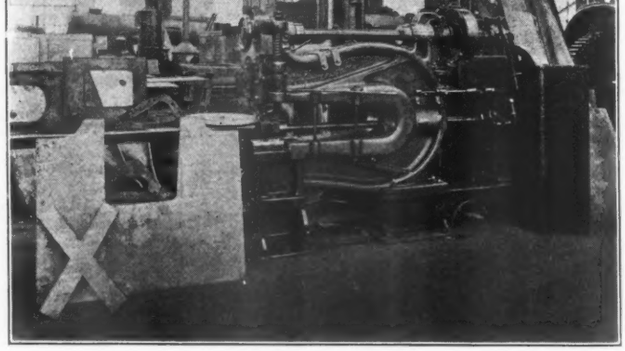
A machinery renewal fund should exist in every works based on a ten years' life of the machinery in order to allow for both wear and tear and obsolescence. The introduction of high speed steel between 1903 and 1910 put many machines simultaneously on the scrap heap; higher speed steels and compound cutting metals such as "Stellite" are in sight, and funds should be available in every shop to enable the fullest advantage to be taken of such improvements.

The author does not advocate the wholesale purchase of new and more powerful machines purely on an arbitrary basis. The method of procedure must be based on a knowledge of the existing annual output of each article dealt with. These records are easily obtainable from the time sheets.



A Bending Press for All Kinds of Work That Has Given Splendid Results

To illustrate this procedure more fully an example is given in connection with drilling operations. These jobs carried out on three old machines have been tabulated with existing prices or costs; new piecework prices have been worked out for these articles by the rate fixer on the basis attainable with the new machine (in most cases it is good policy to send samples to the machine tool maker and obtain guaranteed times), a balance sheet is then prepared as illustrated in Fig. 1, showing the return obtainable on the capital expenditure. After all necessary allowances have been made the return should be such as to enable the machine to make its own contribution to the renewal and obsolescence fund, or in other words, it is



Gray's Sheet Metal Cutting Machine

* An abstract of a paper presented to the Institution of Locomotive Engineers, England.

hardly justifiable to purchase a new machine unless a return of approximately 8 per cent on the capital expenditure is obtainable.

There is another broader and more approximate way of looking at the problem on the basis that where two new machines can be installed to do the work of three existing ones, the gain in floor space and the reduction in labor cost will justify a capital expenditure of £2,000 ($10,000), 10 per cent on this sum representing the cost of one machinist's wages per

Factors in Economical Shop Production

Modern high speed machines must be filled with work to their full capacity if an adequate return is to be obtained from them; this requirement involves either a large stock of locomotives very fully standardized or the manufacture of parts for stock, or a combination of both these requirements. Intelligent manufacture for stock involves a knowledge of the maximum and minimum weekly or monthly demands for each article, which in turn demands the issue of all ma-

Article.	Annual Quantity.	Old Conditions.* Price.	Old Conditions.* Total Cost.	New Conditions.* Price Based on these Times	New Conditions.* Total Cost.	Saving.
		s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.
Mechanical capstan heads	24	6 2¾ dozen	0 12 5½	4 0 dozen	0 8 0	0 4 5½
Hydraulic capstan heads	60	1 3 each	3 15 0	0 10 each	2 10 0	1 5 0
Electric capstan valve	24	1 3 each	1 10 0	0 10 each	1 0 0	0 10 0
Standard 10-ton crane sides	6	23 4 each	7 0 0	15 9 each	4 14 6	2 5 6
Standard 10-ton crane roller box	6	14 10 each	4 9 0	9 11 each	2 19 6	1 9 6
Standard 5-ton crane sides	6	20 2¾ each	6 1 4½	13 6 each	4 1 0	2 0 4½
Standard 5-ton crane roller box	6	14 10 each	4 9 0	9 11 each	2 19 6	1 9 6
Crank ingots (drilling through for parting in two)	30	13 3¾ each	19 19 4½	8 10 each	13 5 0	6 14 4½
Crank slabs for solid slabs	30	14 5¾ each	21 14 4½	9 6 each	14 5 0	7 9 4½
Cylinders for stuffing box 8 cwt. hammer	12	8 6¼ each	5 2 3	5 8 each	3 8 0	1 14 3
Grids and frames for gulleys	72	6 2¾ dozen	1 17 4½	4 0 dozen	1 4 0	0 13 4½
Piston rod for 8 cwt. steam hammer	10	10 10¾ each	5 8 11½	7 2 each	3 11 8	1 17 3½
Hydrant standard valve box cover	18	6 2¾ dozen	0 9 4¼	4 0 dozen	0 6 0	0 3 4¼
150 horsepower motor solid axle frames	10	2 3½ each	1 2 11	1 5 each	0 14 2	0 8 9
150 horsepower motor carcase	12	20 2¾ each	12 2 9	13 4 each	8 0 0	4 2 9
200 horsepower motor carcase (solid, drilled complete)	30	37 5½ each	56 3 9	24 10 each	37 5 0	18 18 9
Parachute inlet valves	24	5 5½ dozen	0 10 11	3 6 dozen	0 7 0	0 3 11
Shear blades for high level shears	36	1 6½ each	2 15 6	1 1 each	1 19 0	0 16 6
Water column parachute base plate	6	10 10¾ each	3 5 4½	7 2 each	2 3 0	1 2 4½
Water column standard parachute base plate pipe	18	7 0 dozen	0 10 6	4 8 dozen	0 7 0	0 3 6
Water trough, C. I. (all sizes)	12	2 8¾ each	1 12 9	1 10 each	1 2 0	0 10 9
Bands and gudgeons for gates	12 sets	9 4 set	5 12 0	6 2 set	3 14 0	1 18 0
Flanges, C. I.	36	9 4 dozen	1 8 0	6 2 dozen	0 18 6	0 9 6
Lamp bodies	72	3 1¼ dozen	0 18 7½	2 0 dozen	0 12 0	0 6 7½
Lamp belts	72	1 11¼ dozen	0 11 7½	1 4 dozen	0 8 0	0 3 7½
Lamp knobs	72	1 6½ dozen	0 9 3	1 0 dozen	0 6 0	0 3 3
Motor armature spider	12	3 4 each	2 0 0	2 2½ each	1 6 6	0 13 6
Nuts, triangular	864	6 2¾ gross	1 17 4½	4 0 gross	1 4 0	0 13 4½
Platform seat brackets	24	9 4 dozen	0 18 8	6 2 dozen	0 12 4	0 6 4
Shackles for swivel hooks	96	3 1¼ dozen	1 4 10	2 1 dozen	0 16 8	0 8 2
Turntable centre pin	144	1 9¾ each	13 1 0	1 3 each	9 0 9	4 1 0
Tube plate template	1	40 9½ each	2 0 9½	27 2 each	1 7 2	0 13 7½
Jib foot for 5-ton crane	12	4 3¼ each	2 11 3	2 10 each	1 14 0	0 17 3
Crossbar for 5-ton crane	12	5 7 each	3 7 0	3 8 each	2 4 0	1 3 0
Hydraulic crane jib, 2 uprights and 1 centre	4	24 7½ each	4 18 6	16 4 each	3 5 6	1 13 0
Hydraulic crane cylinder	8	8 6¼ each	3 8 2	5 6 each	2 4 0	1 4 2
Foundation plate for electric capstan	4	5 5¼ each	1 1 9	3 7 each	0 14 4	0 7 5
Candlesticks for electric capstan	12	10 10¾ dozen	0 10 10¾	7 2 dozen	0 7 2	0 3 8¾
Worm wheel box for electric capstan	4	1 3½ each	0 5 2	0 10 each	0 3 4	0 1 10
Coal box bottoms	12	6 2¾ dozen	0 6 2¾	4 3 dozen	0 4 3	0 1 11¾
Coal box levers	12	7 9 dozen	0 7 9	5 10 dozen	0 5 10	0 1 11
Crank shaft for hydraulic capstan	24	2 1¾ each	2 11 6	1 6 each	1 16 0	0 15 6
Cylinders for hydraulic capstan	12	5 5½ each	3 5 6	3 9 each	2 5 0	1 0 6
Foundation plate for hydraulic capstan	12	5 5¼ each	3 5 3	3 8 each	2 4 0	1 1 3
Bushes for large shaft	12 prs.	4 11¼ pair	2 19 3	3 4 pair	2 0 0	0 19 3
Other miscellaneous work	..	.....	136 12 0	.....	97 13 1	38 18 11
War wage, 21/6 + 7½% on total earnings	..	.....	200 1 3	.....	133 16 10	66 4 5
			£556 6 7¼	.....	£377 11 10	£178 14 9¼

Or 32.12 per cent Saving on Old Prices.

* Old conditions: 3 drillers, 3 machines. New conditions: 2 drillers, 1 machine.

PARTICULARS OF MACHINES DISPLACED.

	£ s. d.
R. 16, 6 ft. 6 in. Radial Drilling Machine, ex Messrs. Muir & Co.	188 0 0
R. 18, 6 ft. 6 in. Radial Drilling Machine, ex Messrs. Muir & Co.	188 0 0
R. 22, 8 ft. Radial Drilling Machine, ex Messrs. Craven Bros.	190 0 0
	£566 0 0

	£ s. d.
Cost of new machine	1,069 15 0
Cost of mains	30 0 0
Cost of motor (10 b.h.p.), Horwich make	80 0 0
Cost of starter and switch gear	23 8 0
Cost of taking out old machines and fixing new one	15 0 0
	1,218 3 0
Less credit for old machines	130 0 0
	£1,088 3 0

	Wages as per other side	Repairs at 5% per annum	Depreciation at 5% per annum	Total.
	£ s. d.	£ s. d	£ s. d.	£ s. d.
Old conditions	556 6 7¼	28 6 0	28 6 0	612 18 7¼
New conditions	377 11 10	54 8 0	54 8 0	486 7 10
	178 14 9¼	26 2 0	26 2 0	126 10 9¼

Or, 11.62 per cent Profit on Investment.

Machine Ordered, August 14, 1919.
Machine received.....
Account passed.....

Fig. 1—Balance Sheet for One New 6-ft. Radial Drilling Machine to Replace Three Old Drills

annum. When the purchase of a machine has been decided upon, a profit and loss ledger account is opened in the works manager's department, which shows the work done by the machine and the economy effected over the piecework prices, which would have had to be paid had the old machine been retained. The exact return attained by the purchase of new machines over a period of years is therefore known. The above are both rough and ready methods, open to considerable criticism from an accountant's point of view, but in practice they produce good results.

chined or manufactured parts, whether new or repaired through the books of a finished work store.

Other salient points requiring the closest possible attention are:—

(1) The reduction of unnecessary work to a minimum; this can be effected by—

(*a*) Inspection of all parts of the locomotive after stripping and cleaning for both flaws and wear; this procedure confines the functions of the machine shop to their legitimate sphere of effecting repairs on definite lines laid down by the management.

(*b*) Elimination of all unnecessary machining operations; this can only be satisfactorily effected by the use of operation sheets, samples of which

are shown in Figs. 2 and 3. Close scrutinizing of machining operations by a competent staff of young foremen with modern ideas will often result in a surprisingly large elimination of unnecessary operations.

(*c*) Elimination of fitting operations by the use of limit gages, jigs, machining particularly by grinding instead of scraping, filing, and chipping, *e. g.*, no scraping should be done on any surface which can be reached by a grinding machine; every use of the chisel or file should be regarded as an adverse criticism of the quality of the machine work or the system of standardization, or the design.

(2) The reduction of unnecessary transportation of material by—

(*a*) Such methods as the arrangement of all white metalling and coppersmiths' work in the closest vicinity to the erecting shop; suitable location of the cleaning boshes and labor-saving appliances in connection therewith.

(*b*) Locating benches in the vicinity of the machines principally dealing with the work of those benches.

(*c*) By the retention in the erecting shop of all material proved by inspection not to require repairs.

(3) The closest economy in the use of material to be effected—

(*a*) By specialized inspection for wear, relieving the fitter of the responsibility for deciding when a part is to be renewed.

(*b*) By a continuous watch for fresh points where wear can be reduced by the use of hardened and ground surfaces.

LANCASHIRE & YORKSHIRE RAILWAY.
MACHINE SHOP
Horwich Works.

MASTER OPERATION CARD.

Article Piston Valve Head
Drawing No. 12380 Date July 1918
Pattern No 1255. Material C. I.

Operation No.	Description of Operation.	Limit Gauges.	Jig No.	Fixtures.	Machine No	Section.	Price each Time s.	d.	H.	Value M.
1st	Turning & Boring	M.119, M.120, M.125, M.126, M.135, M.139, M.140, M.145, M.149, M.159, M.160			231	9	3	6	2	30
2nd	Marking Out Keyway (Internal)				Bench	8		9		34
3rd	Slotting Keyways	M 391			173	2		11½		17
4th	Marking Out Keyway (External)				Bench	8		9		34
5th	Slot Drilling Keyway	M 390	M1		11	7		11½		17
6th	Fitting up for Drilling				Bench	8				
7th	Drilling & Tapping	M.130, M.113, M.129,	M2 M3		33	7	7	8½	6	0
8th	Fitting Ball Release Valves Caps				Bench	8				
9th	Facing up — do —				240	9		7½		27
10th	Fitting Ball Release Valves Seatings & Grinding on Caps				Bench	8	5	9¾	4	7
11th	Adjusting Rings				240	9	3	0½	2	11
					Total		22	11	16	54

Fig. 2—Time and Cost Involved in Finishing a Piston Valve Head in July, 1918 (See Also Fig. 3.)

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MACHINE SHOP
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Article Piston Valve Head
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Operation No.	Description of Operation.	Limit Gauges	Jig No.	Fixtures	Machine No	Section.	Price each Time s.	d.	H.	Value M
1st	Turning & Boring	M.119, M.120, M.125, M.126, M.135, M.139, M.140, M.145, M.149, M.159, M.160			231	9	3	6	2	30
2nd	Broaching Keyway	M 391			324	5		2½		8½
3rd	Slot Drilling Keyway	M 390	M1		173	2		11½		17
4th	Fitting up for Drilling				Bench	8				
5th	Drilling & Tapping	M.130, M.113, M.129,	M2 M3		33	7	7	8½	6	0
6th	Fitting Ball Release Valve Caps				Bench	8				
7th	Facing up — do —				240	9		7½		27
8th	Fitting Ball Release Valves Seatings & Grinding on Caps				Bench	8	5	9¾	4	7
9th	Adjusting Rings.				240	9	3	0½	2	11
					Total		21	2¾	15	10½

Fig. 3—Improvements Made in Piston Valve Head Job in July, 1919 (Compare With Fig. 3)

(*c*) By the extensive use of graduated sizes of pins and holes and by the use of renewable hardened and ground bushes wherever possible.

(*d*) By the regular inspection of all scrapped material with the object of reconditioning or utilizing for the manufacture of new articles of a smaller size, and directing scrap to the points where it could be best worked up. A scrap inspection shop should be a unit in every large locomotive repair shop, serving the dual purpose of saving material and improving design.

(*e*) By the close analysis of the cause of renewal of any parts of which any appreciable quantity have to be renewed annually.

Half year ending	Total No. of engines in stock	Total No. of engines repaired	Total No. of boilers repaired	No. of boilers repaired —taken out of frames	No. fitted with new firebox	No. fitted with new copper tube plate	No. fitted with new ¾ or ½ copper sides	No. fitted with new copper door plate	No. fitted with new steel door plate	No. of firebox patches	No. of barrel patches	No. of crown plate patches	No. of door plate patches	No. of copper stays renewed	No. fitted with new tubes	No. fitted with pieced tubes	No. of renewal boilers built	No. of renewal boilers fitted
June, 1900	1,343	434	367	31	22	8	...	...	...	...	...	...	...	.....	67	79	16	10
December, 1900	1,360	422	394	62	25	3	...	...	...	...	...	...	...	.....	81	61	22	24
June, 1901	1,378	356	309	34	33	11	...	...	...	...	...	...	...	.....	81	62	13	20
December, 1901	1,397	390	331	76	24	14	1	...	...	...	...	...	...	.....	91	76	14	22
June, 1902	1,412	393	358	96	21	32	2	...	...	...	...	...	...	.....	124	78	45	29
December, 1902	1,427	451	392	61	10	25	9	...	...	...	...	...	...	.....	142	91	56	41
June, 1903	1,432	416	339	56	11	19	1	...	...	...	...	...	...	.....	133	60	31	39
December, 1903	1,438	446	376	54	5	33	3	...	...	...	...	...	...	.....	140	85	37	44
June, 1904	1,443	373	315	51	8	34	5	...	No Particulars.					.....	111	69	39	32
December, 1904	1,448	427	357	39	2	41	15	...	...	...	...	...	...	.....	172	61	27	35
June, 1905	1,448	385	332	48	8	24	11	...	...	...	...	...	...	.....	172	96	37	42
December, 1905	1,449	405	333	56	3	35	14	...	...	...	...	...	...	.....	189	77	41	41
June, 1906	1,463	404	354	47	7	43	3	...	...	...	...	...	...	.....	160	57	22	28
December, 1906	1,478	423	368	50	7	37	17	...	...	...	...	...	...	.....	181	63	46	35
June, 1907	1,491	451	388	42	4	41	20	...	...	...	...	...	...	.....	178	78	33	42
December, 1907	1,511	458	386	58	6	36	16	3	33	17	38	27	105	46,987	170	101	25	28
June, 1908	1,510	430	376	55	11	46	14	4	36	19	29	36	112	45,101	202	79	30	24
December, 1908	1,510	410	358	60	2	30	19	6	23	22	19	27	99	49,646	225	86	43	43
June, 1909	1,511	380	327	67	5	40	18	3	37	12	25	16	73	45,428	137	124	34	33
December, 1909	1,523	413	329	75	8	51	8	4	43	13	17	14	85	48,278	194	121	52	50
June, 1910	1,531	410	347	69	6	46	8	6	26	6	11	17	71	50,672	198	116	61	60
December, 1910	1,527	411	373	69	2	44	1	9	22	6	22	11	79	46,870	173	141	46	59
June, 1911	1,541	406	374	67	...	49	5	5	37	7	7	6	96	33,328	114	204	57	43
December, 1911	1,549	242	196	52	...	37	...	4	16	5	6	7	68	27,169	80	114	25	34
June, 1912	1,554	286	244	76	4	55	3	4	45	4	12	19	49	37,026	94	141	53	44
December, 1912	1,557	350	300	85	2	66	11	4	54	11	6	17	140	45,865	143	161	41	51
June, 1913	1,566	374	290	99	2	89	10	2	66	12	12	7	136	51,853	131	173	44	46
December, 1913	1,577	381	344	112	3	63	10	2	53	21	14	5	155	46,171	142	182	68	58
June, 1914	1,573	376	309	91	2	67	5	5	49	12	12	3	90	34,615	154	165	60	63
December, 1914	1,575	326	284	77	...	45	7	2	26	12	10	1	82	28,832	158	119	46	38
June, 1915	1,572	335	263	85	...	73	8	2	51	1	10	...	67	35,840	172	117	52	55
December, 1915	1,573	330	282	89	2	57	11	2	34	6	14	2	128	31,874	151	123	64	56
June, 1916	1,572	335	252	72	...	61	9	2	36	9	14	...	115	30,703	169	114	70	70
December, 1916	1,579	258	221	66	...	48	9	...	24	2	5	...	41	29,797	134	94	44	43
June, 1917	1,585	331	294	82	...	57	6	2	26	13	8	...	65	37,696	163	104	35	36
December, 1917	1,599	319	287	77	...	63	6	2	31	9	4	...	116	33,102	175	93	39	32
June, 1918	1,609	335	285	75	...	56	10	2	29	14	2	...	76	34,723	181	112	25	26
December, 1918	1,621	263	244	58	1	60	7	2	29	10	4	...	75	24,463	133	106	23	23
June, 1919	1,632	265	233	74	...	48	5	4	19	2	...	...	44	23,692	130	99	34	33
December, 1919	1,645	310	292	72	...	44	5	1	14	6	1	...	63	29,030	166	98	47	35
Totals	60,509	14,910	12,803	2,665	246	1,731	312	82	859	251	302	215	2,230	948,676	5,911	4,180	1,597	1,567
Average per half year	1,513	373	320	67	6	43	8	3	34	10	12	9	89	37,947	148	104	40	39

Fig. 4—Table Showing Particulars of Boiler Repairs on L. & Y. Boilers, 20 Years Ending December, 1919

(*f*) By the elimination of the more expensive metals wherever possible.
(*g*) By the judicious use of welding and patching, it being remembered that all patching likely to prove a source of maintenance at sheds should be rigorously avoided.
(*h*) As 80 per cent of the engines stopped for back shop repairs are taken out of service on account of the condition of the boiler, a close watch of the trend of boiler repairs is necessary and a statistical record is kept, as shown in Fig. 4.

Boiler Repairs

The efficiency of the methods of boiler repairs in the shop is checked by the reports of three boiler inspectors on the works manager's staff, specially selected for independence and matureness of judgment in connection with boiler work. These inspectors report quarterly on the condition of the boilers examined. Fig. 4 shows particulars of boiler repairs for 20 years by half yearly periods. A summary of the reports for the last nine years is also given in Fig. 5, from which it will be seen that, in spite of the fact that the ratio of the total number of boilers repaired to the total engines in stock is becoming smaller, the condition of the boilers generally shows a steady improvement.

Particulars	1911	1912	1913	1914	1915	1916	1917	1918	1919
Engine with 12 or more permanent plugs in tubeplate	246	225	120	56	42	32	17	14	6
Firebox side thin....	80	117	60	40	36	27	19	20	15
Firebox with small stays	6	37	15	13	9	9	18	11	6
Engines stopped for broken stays, etc..	36	46	10	..	4	3	2	6	4
Engines stopped for broken roof links..	9	3	1	3	2	..	2	1	1
Engines with bad tubes	22	31	4	2	10	5	2	1	8
Number of engines examined	1,758	1,745	1,767	1,786	1,821	1,779	1,776	1,730	1,699

Fig. 5—Summary of Boiler Inspectors' Report, 1911 to 1919 Inclusive

The erecting shop usually represents about 25 per cent of the total area of a locomotive repair shop; every effort therefore should be directed to reducing the time spent on the erecting shop pits to a minimum.

It is good policy to have a small stock of boilers of each class tubed, mounted, and tested ready to drop into the frames as soon as the frame repairs permit after the old boiler has been lifted out.

To avoid transport of boilers, as much of the boiler repairs as possible should be carried out in the erecting shop. By this is meant such repairs as do not involve machining other than that which can be done by pneumatic or electric portable tools, of which there should be a generous supply; all such tools should be under the special supervision of one man and such an occurrence as an inefficient tool, an air leakage or waiting for a tool should be made an impossibility. The author in his own practice has to a large extent standardized patches which are sent across from the boiler shop shaped and drilled.

Scheduling Repairs

While systematic scheduling of dates on which repair material is to be ready and engines are to be ready for trial is essential, such scheduling is ineffective unless regulated and modified by a daily foremen's conference consisting of the machine, erecting and boiler shops, foundry and smithy foremen as official members, with other foremen called in as required. At Horwich this conference is presided over by the chief works inspector. Supplementing this daily foremen's conference is the work of the progress man attached to each of the principal shops. The progress man's sole duty is to follow up the material required by the charge-hands according to the output boards for repaired engines, and the schedule for new engines. An illustration of the repaired engine output board is shown in Fig. 6.

In dealing with engine repairs the work continually fluctuates, due to defects developing on examination after stripping and to changes in the requirements of the outdoor department; daily changes are therefore necessary in the repair program and the method of conference by the foreman enables immediate decision to be taken to meet the change of circumstance.

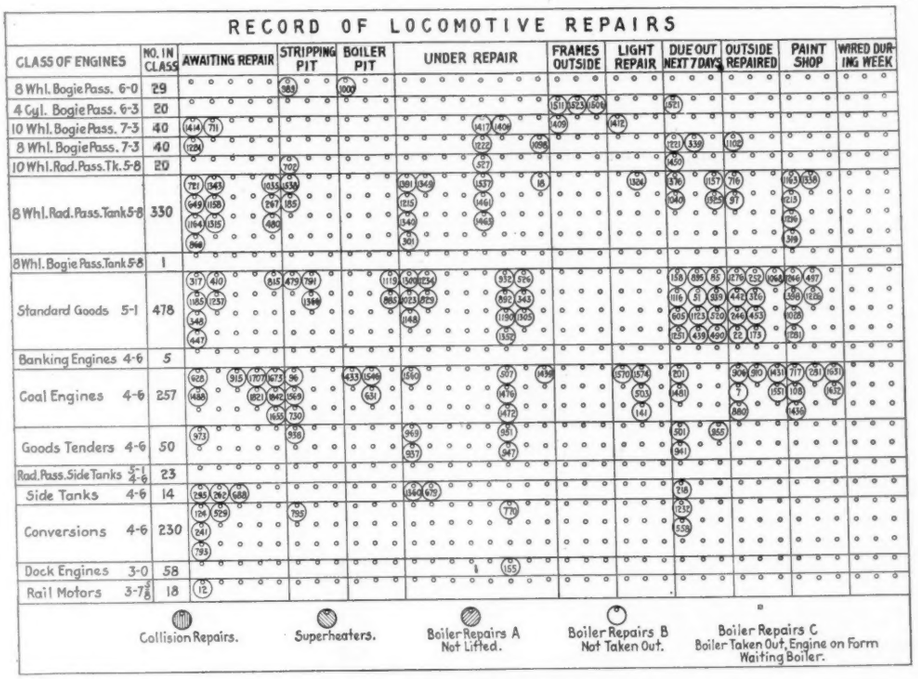


Fig. 6—Repaired Engine Output Board

Points to Be Remembered

Before describing repair methods the author would like to emphasize a few cardinal points which have, as far as possible, been always kept prominently before the management at Horwich:—

(1) The necessity for keeping the boiler stock young; the L. & Y. have a definite renewal fund which permits of the building of boilers at a rate equivalent to a life of 16 to 17 years.
(2) The desirability of reducing firebox patching to an absolute minimum *vide* the table in Fig. 4.
(3) The importance of the greatest possible use of machinery in order to economize labor.
(4) The adoption of piecework or payment by results throughout the shops coupled with an endeavor to secure the reasonable and intelligent co-operation of labor in obtaining a maximum output.
(5) The infusion of a spirit of broad-minded economy and esprit-de-corps into the supervisory staff.
(6) The most vigorous adhesion to standards; in thtis connection the author regards the drawing office staff acting in collusion with the outdoor locomotive department,* as tending unconsciously to be the worst offenders against standardization; it is generally far too easy to set a radical change in motion in some small detail which may have far-reaching consequences. No alteration should be permissible in any drawing which has not been considered by a committee representing the shop, drawing and outdoor locomotive departments. Adherence to old standards which are unsuitable in strength or design for the mere sake of standardization is, of course, undesirable.

*Outdoor locomotive department, as the words indicate, refers to the organization for handling locomotives out on the road and at engine houses.

The only road to progress is that of continual criticism and continual dissatisfaction with the results obtained; the point may be illustrated by the story of the man who said "he had

done his best"; his superior's answer was "that will not do for me; you must try to do better than your best."

Costs

There is no essential need for the management to know the actual cost of every article manufactured or repaired; but it is essential to have accurate costings of groups, *i.e.*, the cost of repairs each year of each class of engine must be known, as must also the cost of each batch of new engines; these costs again should be subdivided into the costs of boilers, smokeboxes, tanks, frames and stays, cylinders, valves, motion, wheels and axles, brake gear, injectors, piping, etc. However, the works manager should be able to call for and obtain within a reasonable time the cost of any article; this is the case on the L. & Y., though the method of sudividing the cost of class repairs into cross headings of groups has not as yet been adopted.

It may not be obvious why extensive costing is not of great value in locomotive repair work, but a little consideration will show that the price of materials is dictated by the outside market, and the piecework prices of labor are fixed, and all reductions of cost must be made by new methods or new machinery or economy in material. Whether these reductions are being made is revealed by the balance sheets and ledger accounts for new machines, by the wages sheets of individual shops, and by the returns of scrap sold or utilized.

The broad costing divisions show tendencies; they indicate, for instance, in the case of tank engines, whether the time is coming when a large number of new tank engines would not be a more profitable investment than repairing the old ones.

In addition to the above costing and statistical checks on the efficiency of the organization, the management must have other figures constantly before them; on the L. & Y. this consists of:

(1) Monthly statements of the weight and cost of materials issued.
(2) Weekly statements of the wages paid, and number of men employed in each shop.
(3) A cross division of the wages paid under the following heads:
Engine repairs.
Boiler renewals.
New engines.
Renewal of machinery and plant, subdivided under—
(*a*) Machinery and plant generally.
(*b*) Engines and boilers.
(*c*) Hearths and furnaces.
(*d*) Cranes.
(*e*) Sundries.
Other workshop expenses, subdivided under—
(*a*) Foremen.
(*b*) Checking and inspectors.
(*c*) Cranemen, tramwaymen, stationary enginemen, etc.
(*d*) Laborers.
(*e*) Light and power.
(*f*) Tools and fittings.
(*g*) Pattern-making.
(*h*) Sundries.
Repairs to premises, and various other miscellaneous items.

The cost of castings, forgings, and smithy work is watched by means of balance sheets which are prepared on the same lines as if the smithy, foundry or forge were working as an outside shop supplying the machine, erecting and other shops; therefore so far as the supply of semi-manufactured material is concerned, the works manager is in the position of knowing exactly how he stands in regard to the comparative costs as compared with supplies from outside manufacturers. Owing to the standardization of the product, the actual works cost is necessarily little if any higher than that of a manufacturer, while the manufacturer's general charges, which are bound to be high on account of his necessity for advertising, preparing quotations and estimates, etc., are saved.

Operating Department the Shop's Customer

There is a further test of efficiency and financial solvency. The outdoor locomotive department must be considered as the customers of the shop. No commercial shop can be solvent that has dissatisfied customers. Unfortunately there is and can be no financial test of the commercial solvency of a locomotive repair works, but the satisfaction or otherwise of their customers, the outdoor locomotive department, is probably the best possible test under the circumstances. The policy of the works should therefore be to invite complaints from the outdoor locomotive department, and this is done as far as possible on the L. & Y. by the system of returned waybills and by the trial run of each repaired engine on an easy traffic job, the report of the trial being made by a driver who is independent of the shop staff, and is not hampered or prejudiced by the presence on the engine of any of the men who repaired it.

This does not mean that the outdoor locomotive department should be under any control other than that of the chief mechanical engineer. Any such system means the setting up of co-equal rival authorities in a technical subject within one organization which cannot make for harmony or efficiency.

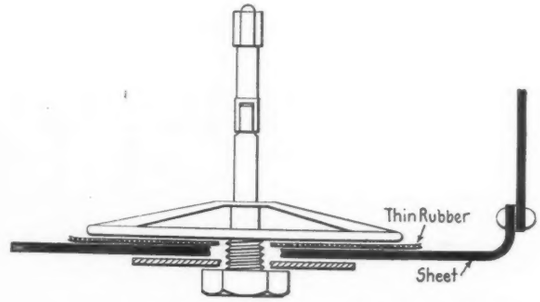
Co-operation the Keynote

The nearest possible approach to the best results in dealing with locomotive repairs is only attainable if the whole of the grades and groups engaged in the work deal with it in a spirit of self-sacrifice, completely sinking their own personal interests for the good of the whole; the general outline of locomotive repair work is so standardized that except in so far as progress on the broad lines indicated earlier in this paper is concerned, there is more engineering of human nature than of material in the work.

NOTE: *The author included two appendices to the paper describing the routine of engine repairs and the application of limit gages and progressive sizes in the machine shop which will be published in future issues* —EDITOR.

Emergency Patch Plate Made of Old Air Signal Valve Part

A hole was accidently knocked in the sheet metal water tank of some road equipment. Due to the fact that the sheet in that particular place was badly rusted it was impossible to plug the opening, and a patch of some kind had to be applied in a hurry. The sketch shows how an old signal



Air Signal Valve Part Used in Patching Sheet Metal Tank

valve stem and plate was utilized in making a very satisfactory small patch. The sheet did not allow a full nut to be drawn, but to hold the water and stop the opening it served the purpose very well. The idea might be useful under similar circumstances where an emergency application of a patch on thin metal sheet is necessary.

Heat Treating Steel in Railway Shops

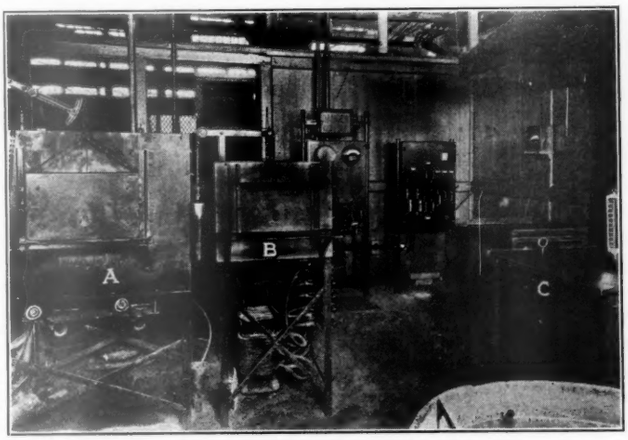
Essential Methods and Equipment Needed in the Heat Treatment of Tool Steel for Railway Shops

BY HENRY OTTO
Tool Foreman, Topeka Shops, Atchison, Topeka & Santa Fe

THE controlling factor in all heat treatment is temperature, whether the operation is annealing, hardening or tempering and for any certain steel and particular use thereof, there is a definite temperature point which alone gives the best results. Insufficient temperatures do not produce the results sought. Excessive temperatures, due either to ignorance of what the correct point is or the inability to tell when it exists, will cause "burned" steel. This is a common failing resulting in great loss. Very slight variations from the proper temperature may do irreparable damage.

Due to temperature variation alone, carbon steel may be had in any of three conditions: First, In an annealed state, when not heated to a temperature above 1,350 deg. F.; Second, In a hardened state, by heating to a temperature between 1,350 and 1,500 deg. F.; Third, In a state softer than the second, though harder than the first, when heated to a temperature which exceeds 1,500 deg. F.

The hardening of carbon steel is the result of a change of



Furnaces and Equipment Used in Heat Treating

internal structure which takes place in the steel when heated properly to a correct temperature. This change for practical purposes is effective only in those carbon steels in which the proportion of carbon varies from two points to twenty points.

Hardening Steel

The process of hardening steel consists essentially of heating it to the required temperature and quenching it suddenly in some cooling medium. The methods of heating and the different kinds of quenching baths used are numerous. Generally speaking, the furnaces are heated either by gas, oil, electricity, or solid fuel. Each of these methods has its advantages according to the local conditions. Electrical furnaces for hardening and tempering are used in the tool room of the Santa Fe shops at Topeka, Kans.

In the actual heating of a piece of steel several requirements are essential to good hardening: First, Small projections or cutting edges must not be heated more rapidly than is the body of the piece; Second, All parts must be heated to a uniform temperature, as low as will give the required hardness. A higher temperature is uneconomical and dangerous.

Any temperature above the "critical point" of steel tends to open its grain, to make it coarse and to diminish its strength. The temperatures at which internal changes in the structure of a steel take place, are frequently spoken of as the "critical" points. These are different in steels of different carbon contents. The carbon steel used for making reamers, taps, shear blades, etc., at Topeka shops has its decalesence point at 1,385 deg. F. and its recalescence point at 1,280 deg. F. The decalescence point is the proper temperature for hardening and the recalescence point is the proper temperature for annealing.

Furnace Equipment

In the tempering room, there are two electrically heated furnaces made by the Hoskins Manufacturing Company. One of these, known as the Type F. C. furnace, is shown at *A* in the illustration. It has a carbon resister and top carbon plates. The service life of these plates is about 125 hours. The graphite bottom plates and electrodes have a life of about 300 working hours and it is necessary to renew them at regular intervals. The time required for renewing depends entirely upon the condition of the walls or lining. This furnace is used only to bring the tools made of high speed steel to the final heat or from 1,700 deg. F. to 2,300 deg. F. Good results have been obtained with the above furnace on high speed steel tools.

The Type F. B. furnace, shown at *B*, is of the hair pin heat unit type, and is designed for lower temperatures, the maximum being 1,800 deg. F. This furnace is used for carbon steel tools and for preheating all the high speed steel tools in connection with the Type F. C. furnace. The heat units are easily renewed and the cost of maintenance is very low. All carbon steel tools are heated in this furnace for hardening. Both of the above furnaces were installed March, 1917, and have given very good results. They are supplied with alternating current through special transformers.

Oil Tempering Bath

The electrically heated oil tempering bath shown at *C* is made by the General Electric Company, and is used in accurately drawing the temper on carbon steel tools. The oil is heated up to the required temperature and the tool left in the bath until it is heated thoroughly to the temperature of the oil. The tool is removed and after cooling is ready for grinding and use.

Not long ago, it was the practice to send a finished tool to the blacksmith shop for tempering. The blacksmith would guess when the temperature was high enough and quench the tool, afterwards drawing the temper to whatever color he thought was right. The results were always nonuniform and unsatisfactory. With up-to-date electrical equipment, it is a matter of reading the pyrometer and bringing the temperature up to that recommended by the steel company.

High Speed Steel

High speed steel must be heated to a much higher temperature for hardening than carbon steel, a temperature from 1,800 to 2,300 deg. F. being used. The usual method of hard-

ening high speed steel tools, such as lathe, planer, slotter tools, etc., is to heat the cutting end slowly to a temperature of about 1,800 deg. F. and then rapidly to about 2,250 deg. F., or until the end of the tool is at a dazzling white heat and shows signs of melting down. The tool point is then cooled either by plunging it in a bath of oil or by placing the end in a blast of dry air.

The exact treatment varies for different steels and it is advisable to follow the directions given by the steel makers. The following is a table of heat colors when tools are heated without using a pyrometer.

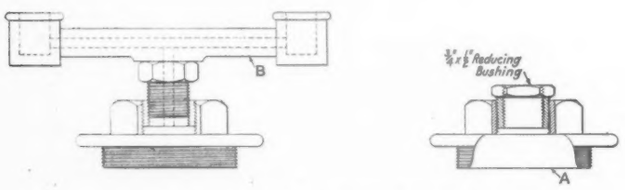
Heat Colors	Degrees Fahrenheit	Heat Colors	Degrees Fahrenheit
White	2,200	Cherry or full red	1,375
Light yellow	1,975	Medium cherry	1,250
Lemon	1,825	Dark cherry	1,175
Orange	1,725	Blood red	1,050
Salmon	1,650	Faint red	900
Bright red	1,550		

In annealing high speed steel an iron box or pipe is used, of sufficient size to allow at least one-half inch of packing between the pieces of steel to be annealed and the sides of the box or pipe. It is not necessary that each piece of steel be kept separate from every other piece, but the steel must be prevented from touching the sides of the annealing pipe or box. It should be packed carefully with powdered charcoal, fine dry lime, or mica and covered with a cap which should be air-tight. The pipe is then heated slowly to a full red heat, about 1,475 or 1,500 deg. F., and held at this heat from two to eight hours, depending on the size of the pieces to be annealed. The parts should be cooled as slowly as possible and not exposed to the air until cold. A good way is to allow the box or pipe to remain in the furnace until cold. Local conditions in heat treatment of steel must be taken into consideration for what is advisable in one place may not be practical in another place.

Repairing Cylinder Cap of Air Compressor Governor

BY F. W. B.

The ½-in. pipe thread in the cylinder cap body of an air compressor governor is often found badly worn, allowing a loose fit for the thread end of the diaphragm body or Siamese fitting. As long as the cap has good close threads, the diaphragm portion or the Siamese fitting can be safely turned to suit the angle or direction of the controlling pipes, but loose threads many times allow the hexagonal wrench portions above to strike the top of the cap with the connections in decidedly contrary directions.



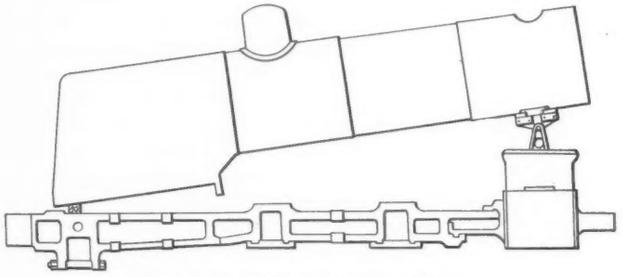
Cylinder Cap After Being Repaired

The illustration shows a quick and inexpensive method of repairing the caps where a number of them can be done at a time. The cap *A* is drilled out for a ¾-in. pipe thread, tapped and a ¾-in. to ½-in. reducing bushing screwed firmly into it. The square of the bushing is then cut off flush with the top of the cap. This affords a good ½-in. thread, perhaps a little small, but just right to take the thread of a body or Siamese fitting *B*, itself somewhat worn. The idea is simple, but provides a most effective way to remedy this defect.

Stool for Supporting Front End of Boiler

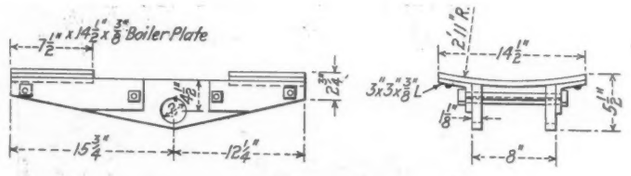
BY E. A. MILLER

When a new saddle is to be applied to a locomotive, it is bolted between the front ends of the frames, and the boiler is put in place. The top flange of the saddle is chalked or painted all around and a line scribed along the sides, front and back of the saddle ¼ in. or any convenient depth below the boiler, to follow as a guide in chipping the saddle to the proper contour. After being so marked the front end of the boiler is lifted up and the stool set in place as illustrated.



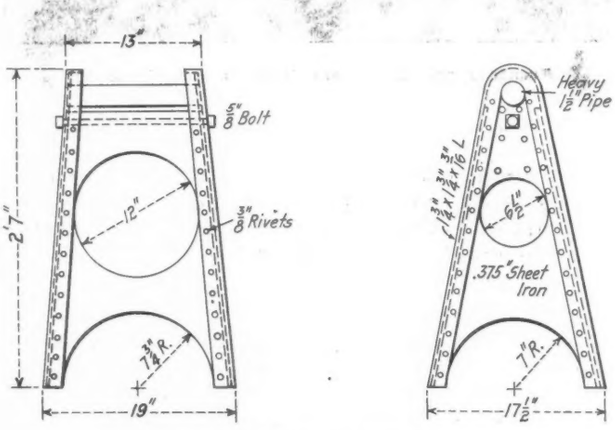
Sketch Showing Application of Stool

The frame of the stool is made of 1¾ in. by 1¾ in. by 3/16 in. angle iron bent at the top around heavy 1½ in. wrought iron pipe, which extends from one side to the other. The frame is stiffened by ⅜-in. sheet iron riveted to the angle irons as shown. A 6½-in. hole is cut in the sides and 12-in. holes in the front and back. The bottoms are cut out as shown.



Fulcrum Plate

The fulcrum plate consists of two 1⅛-in. by 28-in. wrought iron plates, cut to the shape shown and provided with 2-in. holes. The fulcrum plate rocks on a heavy 2-in. wrought iron pipe. Four pieces of 3 in. by ⅜ in. angle are bolted to the plates, and curved plates extend from side to side. These curved plates are made of ⅜ in. boiler plate and are riveted to the angle irons, the rivets being countersunk on top.

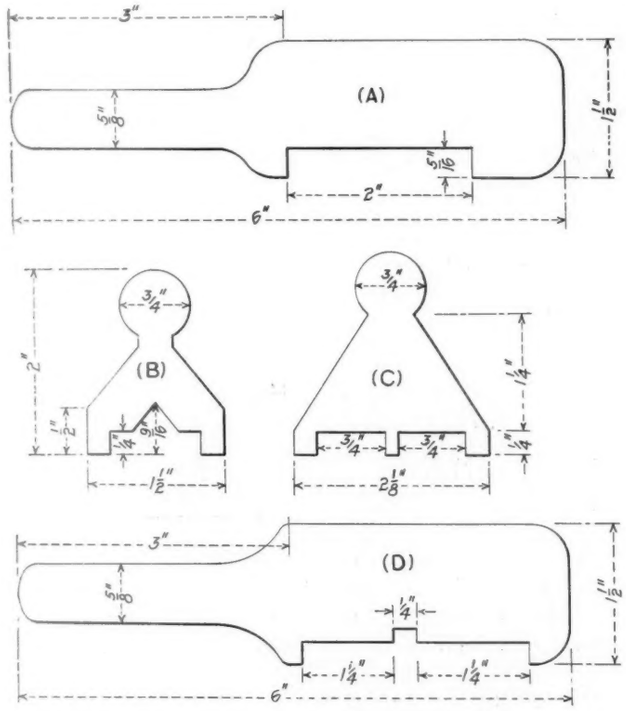


Details of Stool Construction

Standard Gages Facilitate Repairing Valves in Air Brake Department

BY F. A. SKINNER
Air Brake Foreman, Santa Fe Reclamation Yard, Corwith, Ill.

By the use of comparatively simple gages, it has been possible to save a large amount of material and greatly facilitate the work of repairing the various valves used in the air brake equipment. The gages and tools used for this repair work, the majority of which are home-made, have proved their value. The gages are made of 1/16-in. boiler steel carefully shaped to the forms shown. Referring to the illustration, *A* is a gage for testing the springs in pressure retaining valves. There is a tendency among many repair men to stretch this spring with the idea of increasing its tension and thereby preventing the retainer from leaking down. The use of gage *A* will detect springs that have been



Gages Used In Air Brake Repair Work

stretched and they may be replaced by standard springs. This will assure the correct action of the pressure retainer, thereby preventing slid flat wheels.

Gage *B*, shown in the illustration, was devised for the purpose of testing the diaphragm in the maximum pressure head of the pump governor. To use the gage, the parts of the head are assembled and the gage is placed directly over the diaphragm or valve. If it fills the opening, the valve is of the proper length and, if not, it is too short. A new valve can then be installed and no trouble will result from leaky diaphragm valves.

Gage *C* is used to measure the length of the regulating valve in a slide valve feed valve after it has been assembled and the spring box removed. The gage is used in the manner of a straight edge and shows at a glance whether the regulating valve is of the proper length. The slide valve feed valve is one of the most difficult parts of the air brake equipment to repair and its action is absolutely dependent upon the correct length of the regulating valve, so the importance of this gage can be readily appreciated.

Gage *D* is provided for testing the vent valve in an auxiliary release valve, and by its use much time can be saved by assuring that the vent valve is not too short before making the test. To test the vent valve, the part containing the rubber seat is placed in the 1/4-in. slot and if the top of the vent valve touches the top of the gage, the valve is of the proper length and can be reseated. Upon testing the release valve, the length of the vent valve will be found to be correct.

Power Punches and Dies*

The punch and die is one of the most abused tools in the shop. It has to work under all kinds of conditions. Sometimes it has lubrication and more times not, and seldom does the operator take pains to see that the punch is central with the die.

C. M. & St. P. Practice

Fig. 1 shows Chicago, Milwaukee & St. Paul standard punches and dies. The punches are made on automatic machines, the large ones at a labor cost on the machine of

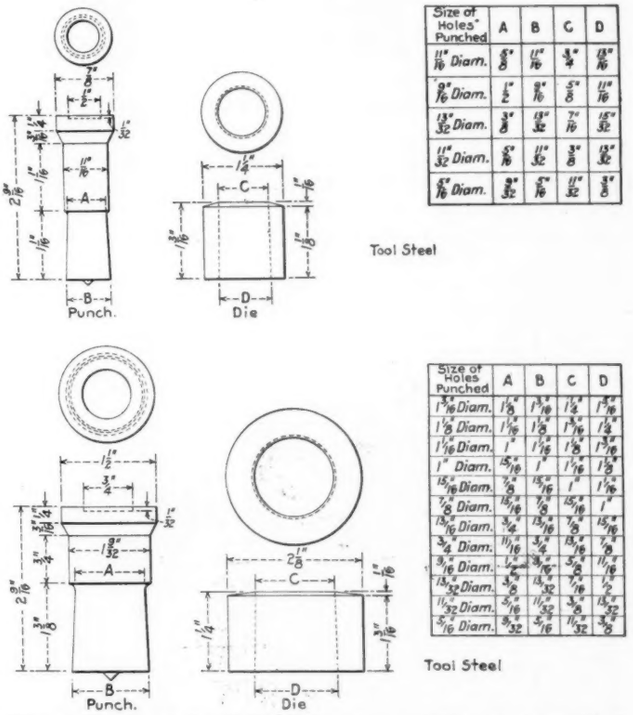


Fig. 1—Large and Small Shank Punches and Dies, C. M. & St. P.

4½ cents each, and the small ones at 3½ cents each, and one cent each for tempering them.

Fig. 2 shows a punch and die for punching convex steel staybolt nuts. These nuts are used in the firebox on radial staybolts, and on crown sheets. The nuts are punched from boiler steel and tapped in a nut tapping machine. Some trouble has been experienced on these punches, the face of the punch pulling off in the stripping. This has been overcome by putting a double taper on the body of the punch; that is, giving it the regular clearance for half of the body and reversing the taper on the other half, so that the punch will act as a drift to open the top of the sheet where it has drawn in. This makes the sheet strip from the punch very easily. More damage is done to a punch in stripping than in punching.

The punches are made of 90 to 100-point carbon tool steel. The larger sizes, when in bad condition on the cutting end, are annealed and reclaimed to a smaller size.

*From a paper read before the American Railway Tool Foremen's Association.

A. T. & S. F. Practice

The sketches show sizes of the standard punches and dies used. These may be ordered on requisition, by a symbol number from one central point—Topeka, Kan.—where a

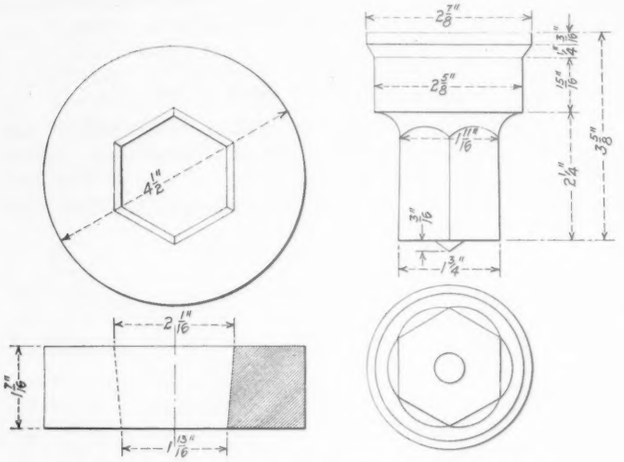
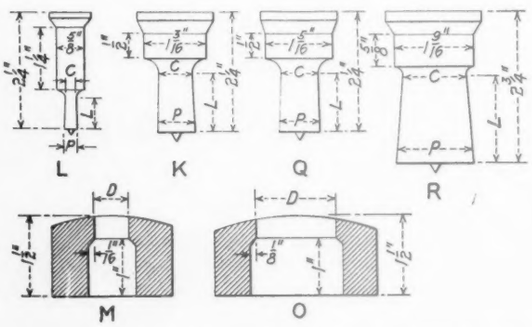


Fig. 2—Punch and Die for Convex Steel Staybolt Nut

sufficient stock is kept on hand to meet the requirements of the different shops along the line. These tools are mostly bought from the manufacturers.

In establishing a standard, the size and shape of the



Punch				Die		Punch				Die	
Sym. No.	P	C	L	Sym. No.	D	Sym. No.	P	C	L	Sym. No.	D
L102	3/16"	5/32"	33/64"	M102	7/32"	K113	7/8"	27/32"	1 13/64"	M113	23/32"
L103	1/4"	7/32"	35/64"	M103	9/32"	K114	15/16"	29/32"	1 15/64"	M114	31/32"
L104	5/16"	9/32"	37/64"	M104	11/32"	K115	1"	31/32"	1 17/64"	M115	1 1/16"
L105	3/8"	11/32"	39/64"	M105	13/32"	K116	1 1/16"	1 1/32"	1 19/64"	M116	1 1/8"
L106	7/16"	13/32"	41/64"	M106	15/32"	K117	1 1/8"	1 3/32"	1 21/64"	M117	1 3/16"
L107	1/2"	15/32"	43/64"	M107	17/32"	K118	1 3/16"	1 5/32"	1 23/64"	M118	1 1/4"
L108	9/16"	17/32"	45/64"	M108	19/32"	Q119	1 1/4"	1 7/32"	1 41/64"	M119	1 5/16"
L109	5/8"	19/32"	47/64"	M109	21/32"	Q120	1 5/16"	1 9/32"	1 43/64"	M120	1 7/16"
K110	11/16"	21/32"	1 7/64"	M110	23/32"	R121	1 3/8"	1 11/32"	1 45/64"	0121	1 1/2"
K111	3/4"	23/32"	1 9/64"	M111	25/32"	R122	1 7/16"	1 13/32"	1 47/64"	0122	1 9/16"
K112	13/16"	25/32"	1 11/64"	M112	27/32"	R123	1 1/2"	1 15/32"	1 49/64"	0123	1 5/8"

Fig. 3—Standard Punches and Dies—A. T. & S. F.

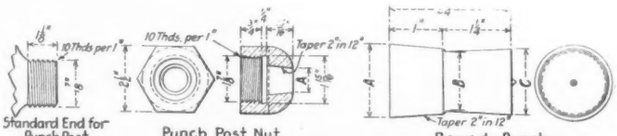
body of the punches and the diameter of the die are the essential points to consider, as the length in a good many cases will depend on the nature of the work and the construction and style of the machine.

Four different sizes of punches and two of dies are shown, although in practice the larger sizes are not much used, as the average punching machine will not handle work large enough to require them.

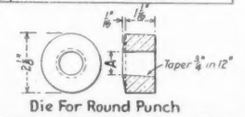
For the ordinary boiler shop punch the coupling nut for the holder is made to fit the larger punch and a bushing or reducer is used to adapt the smaller, or symbol *L* punch, to the same coupling nut. As the punches and dies are of the same length, blocking is not required, unless the punches have been reworked and made shorter.

N. & W. Practice

There were no less than 15 machines distributed in different departments of the Norfolk & Western shops at Roanoke, Va., each having a different type of punch and punch post, with coupling nuts ranging from 1½ in. in diameter to 2¼ in. in diameter, with threads 10 to 14 per inch. Some held the punch in place with set screws, which often could neither be tightened nor loosened. An outfit for one machine was



NUT NO.	A	SIZE OF PUNCHES NUTS WILL TAKE
E-1	1⅞	For Punch No. E-1-b to E-8-b Inc.
E-2	1 15/16	For Punch No. E-9-b to E-11-b Inc.
E-3	1⅞	For Punch No. E-12-b and E-13-b
E-4	1 15/16	For Punch No. E-14-b to E-18-b Inc.



DIE NO.	A	USED WITH PUNCH NO.	DIE NO.	A	USED WITH PUNCH NO.
E-1-a	1/4	E-1-b	E-10-a	15/16	E-10-b
E-2-a	5/16	E-2-b	E-11-a	1	E-11-b
E-3-a	3/8	E-3-b	E-12-a	1 1/16	E-12-b
E-4-a	7/16	E-4-b	E-13-a	1 1/8	E-13-b
E-5-a	1/2	E-5-b	E-14-a	1 3/16	E-14-b
E-6-a	9/16	E-6-b	E-15-a	1 1/4	E-15-b
E-7-a	5/8	E 7-b	E-16-a	1 5/16	E-16-b
E-8-a	11/16	E-8-b	E-17-a	1 3/8	E-17-b
E-9-a	3/4	E-9-b	E-18-a	1 7/16	E-18-b

PUNCH NO.	SIZE OF PUNCH	SHANK NO.	A	B	C
E-1-b	5/16	1	5/8	3/8	5/16
E-2-b	1/2	1	1/8	3/8	1/4
E-3-b	5/16	1	1/8	1/8	5/16
E-4-b	3/8	1	1/8	5/16	3/8
E-5-b	7/16	1	1/8	3/8	7/16
E-6-b	1/2	1	1/8	7/16	1/2
E-7-b	9/16	1	1/8	1/2	9/16
E-8-b	5/8	1	1/8	9/16	5/8
E-9-b	11/16	2	1 1/16	5/8	11/16
E-10-b	3/4	2	1 1/16	11/16	3/4
E-11-b	13/16	2	1 1/16	3/4	13/16
E-12-b	7/8	3	1 3/8	13/16	7/8
E-13-b	15/16	3	1 3/8	7/8	15/16
E-14-b	1"	4	1 3/8	15/16	1"
E-15-b	1 1/16	4	1 3/8	1"	1 1/16
E-16-b	1 1/8	4	1 3/8	1 1/16	1 1/8
E-17-b	1 3/16	4	1 3/8	1 1/8	1 3/16
E-18-b	1 1/4	4	1 3/8	1 3/16	1 1/4

Standard Punch Post, Nuts, Dies and Punches, Norfolk & Western

designed that could be standardized and all the machines have been fitted with the standard equipment.

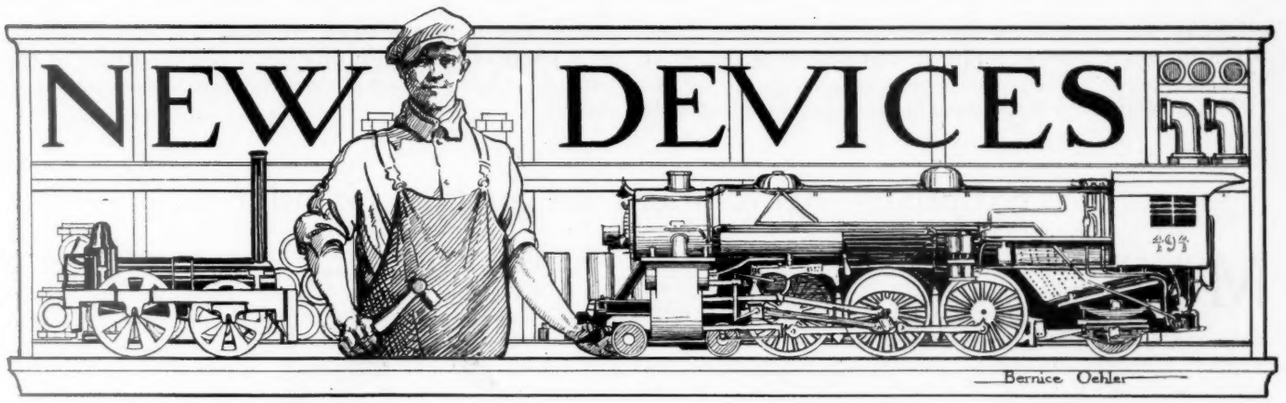
All punch posts have threaded ends 1⅞ in. in diameter, 10 threads per inch. The standard punch is 2¼ in. long. Four sizes of coupling nuts are used:

No. 1 nut taking size ⅜ in. to ⅝ in.—⅞ in. stock.
No. 2 nut taking size ⅝ in. to ⅞ in.—1 1/16 in. stock.
No. 3 nut taking size ⅞ in. to 1 in.—1⅛ in. stock.
No. 4 nut taking size 1 in. to 1¼ in.—1⅜ in. stock

The details of this equipment are shown in Fig. 4.

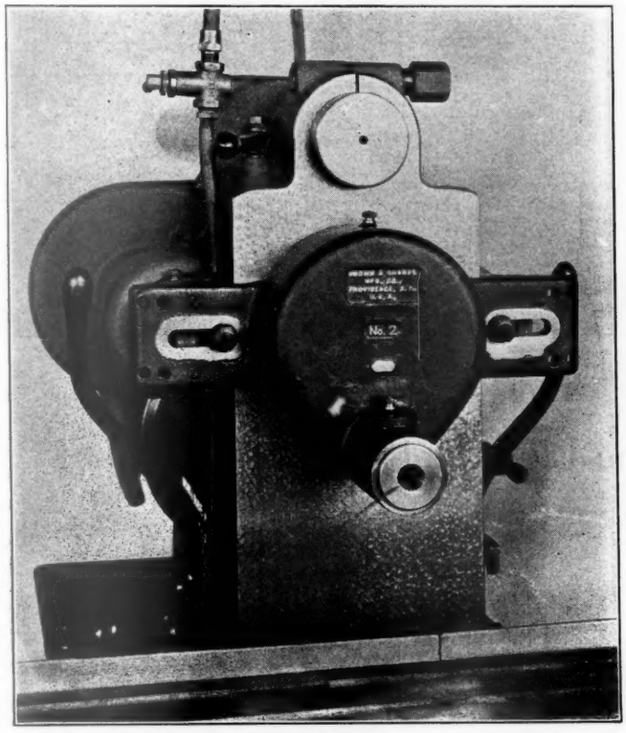
Discussion

The discussion was confined largely to the operation of punches rather than to the development of a standard type of punches, couplings and dies. Owing to the difficulty of getting satisfactory production in drilling flue holes in front tube sheets the St. Louis-San Francisco is experimenting with a spiral punch, sized to leave 1/16-in. stock in the hole to be finished by reaming. So far, it has been found that this punch does not disturb the metal as much as had been expected. No other railroad represented at the convention has taken up this proposition. The Santa Fe practice is to punch a 1-5/16-in. hole and then run through a reamer or two-lip drill. At one time sixty of these holes were drilled an hour, but when the war broke out the schedule was cut to forty an hour and actual production now does not exceed twenty-five an hour.



Easily Applied High Speed Milling Attachment

THE accompanying illustrations show a new design of high speed milling attachment made by the Brown & Sharpe Manufacturing Company, Providence, R. I., for use on milling machines of their manufacture. As will be noted, the mechanism is simple in construction and easily attached to the milling machine, no auxiliary fixtures being required. The bracket and spindle support is a one piece



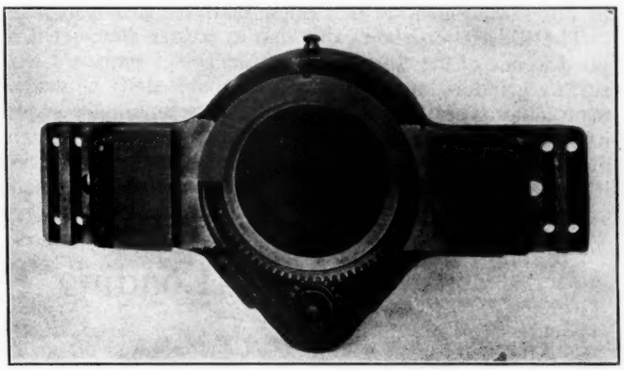
Brown & Sharpe High Speed Milling Attachment

casting of substantial construction, so designed as to protect the mechanism from dirt and injury.

The attachment is built in two sizes: the No. 1 for the smaller machines and the No. 2 for the larger machines. The No. 2 size is adaptable by means of adjustable gib stops to the larger machines having columns with different widths of face, thus eliminating the necessity of a separate attachment for each different size of machine column.

The positive means of locating the attachment is particularly noteworthy. To assure a positive vertical position, the attachment is provided with a locating segment which rests upon the spindle box of the machine. This spindle box projects beyond the face of the column and acts as a centering guide. The horizontal position is determined by first tightening the gib on the right hand side of the attachment, thereby locating the attachment. The gib on the left hand side securely clamps the attachment to the face of the column. This affords a large bearing surface, assuring rigidity and making the attachment practically an integral part of the machine.

Particular attention has been given to the drive that it may be positive and simple, the only gearing being the large ring gear that fits on the taper nose spindle of the machine and the pinion on the attachment spindle. The large gear is made with an internal taper, ground to fit on the taper nose of the machine spindle and is held in position by the regular cutter



Rear View of High Speed Milling Attachment

driver. This gear is made of machinery steel and left soft to provide a smooth drive and eliminate chatter and the objectionable "ring" often produced by hardened gears at high speed. On the No. 2 attachment the pinion is heat treated and keyed to the attachment spindle, while on the No. 1 attachment the teeth of the pinion are cut directly on the spindle.

The spindle is hardened and ground and runs in a long phosphor bronze bearing, the bearing being tapered so that wear is taken up by tightening an adjusting nut, thereby forcing the spindle into the taper. Once having adjusted the spindle, a small set screw securely clamps the adjusting nut in position. End thrust is taken by hardened steel and babbitt washers located directly behind the shoulder on the front end of the spindle. The front end of the spindle has a taper hole to receive cutters, the smaller attachment having a No. 7 taper hole and the larger one a No. 9 taper hole. Oiling the spindle bearing is effectively taken care of by means of an

oil pocket on the front of the attachment containing wool, which insures a constant and even distribution of the oil at all times.

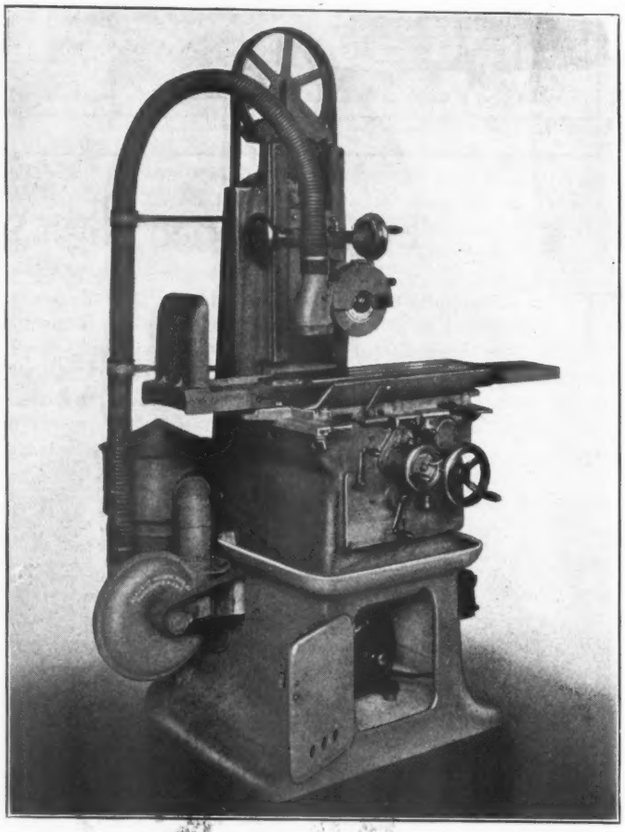
The cutter is held in position by the taper in the spindle and is driven by the tenon. Cutters are readily removed by a releasing bolt which provides a positive means of ejection. This bolt is a part of the attachment and remains in the spindle.

Exhauster Attachment for Surface Grinder

MODERN requirements for the safety and health of the employee demand an efficient device for disposing of the dust generated by grinding machines, especially surface grinders, when operating without the use of water, which is frequently necessary. Where these machines are not placed in groups to be served from one central exhaust system, it is desirable to have the individual machine equipped with its own unit, and in many cases it is really more economical to have each machine of a group individually equipped, as the exhauster is then running only while the machine is in operation. This is especially true where individual motor drive prevails.

Realizing the importance of collecting as much of this dust as practicable, the Abrasive Machine Tool Company, East Providence, R. I., has designed a complete new system for its machines, as shown in the illustration. The exhauster is a machine-tool-built product, equipped with S-K-F ball bearings, and aluminum fan, running at 4,000 r. p. m. The exhauster is connected with the aluminum dust collector on the wheel hood by means of flexible wire-insert rubber suction tubing. The wheel dust is drawn in through the flexible tubing, and forced into the centrifugal drum attached to the rear of the machine, where the dust is separated and deposited at the bottom of the cone. The free air passes out through a circuitous route, and, it is stated, is practically dustless. The accumulation of dust can be removed by unscrewing a cap at the bottom of the separator drum.

The illustration shows the dust exhauster attachment applied to one of the Abrasive Machine Tool Company's No. 3 surface grinders but the application could easily be made to many other types of machines. The question simply resolves itself into a matter of piping to the machine and designing the proper collector for sucking in the dust at the point where it is generated. Application of the parts is then easily made.



Motor Driven Dust Exhauster System

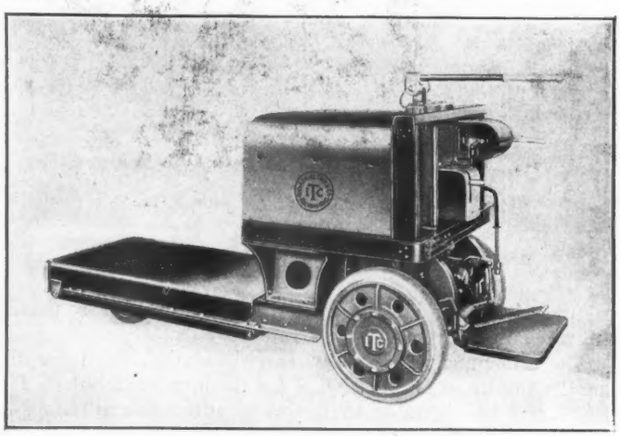
Self-Loading Type Electric Truck

AN industrial self-loading truck of improved design has recently been placed on the market by the Industrial Truck Company division of the Cowan Truck Company, Holyoke, Mass. The truck is of all-steel construction and is guaranteed for 5,000 lb. capacity. It has a quick acting elevating mechanism and elevates in five seconds when equipped with 28 cells and six seconds with 21 cells.

The lifting mechanism is operated by an independent, heavy duty, series wound motor and worm gear reduction. The platform lifts vertically, the rise being 4½ in. The platform may be stopped at any point going up or down, and requires only three seconds for full lowering. The rear end is equipped with a heavy bumper which effectually takes all shocks, and protects the lift platform. A drawbar attachment also is provided which enables the truck to be used as a light duty tractor.

An automatic brake and circuit breaker application, four-wheel steer, single reduction worm drive of the power axle and easy accessibility of batteries, lifting, driving and control mechanism are features of the truck. It will operate in intersecting aisles 60 in. wide.

The extreme turning radius, outside point, is 7 ft. 10 in.



I. T. C. Self-Loading Electric Truck

By folding the foot pedal and steering handle into a vertical position, the overall length is shortened for use on elevators. The length is 102 in. overall or 91½ in. with the

step raised. The width is 36 in. overall and the height over steering shaft head 51 in. Either alkaline or lead batteries are used. The controller is of the drum type with three speeds forward and three reverse.

The new truck has been subjected to rigid tests under actual operating conditions, and promises enduring service due to its all-steel construction, low center of gravity, and general compactness and ruggedness.

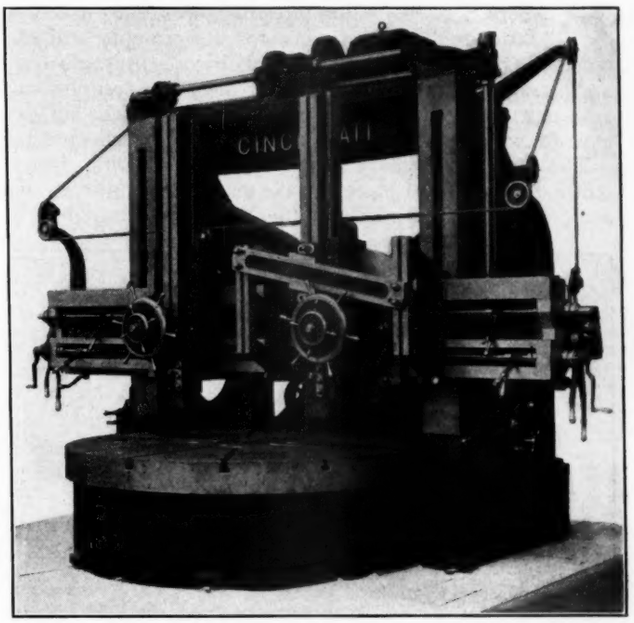
Taper Attachment Applied to Boring Mill

FOR turning and boring tapers approaching nearly a horizontal line to which swiveling the head is not adaptable, a taper turning and boring attachment has been designed for use on boring mills manufactured by the Cincinnati Planer Company, Cincinnati, Ohio. The illustration shows the attachment applied to an 8 ft. mill but it can be adapted to use on all sizes from 42 in. up to 12 ft.

The component parts such as sine bar supports, sine bar, and sine bar guide are all clearly shown in the illustration. To provide up and down adjustment to the ram without loosening the sine bar and thereby changing its position, the faces of the rams are specially machined and fitted with a tee slot in length equal to the up and down travel.

When mounting, the sine bar supports, sine bar guide and sine bar are placed in position loosely and clamped securely in place after the proper angle has been determined. The power feed to the ram is then disengaged by means of the small handwheel making it ready for operation. The use of the taper attachment is recommended for angles up to and including 18 deg.

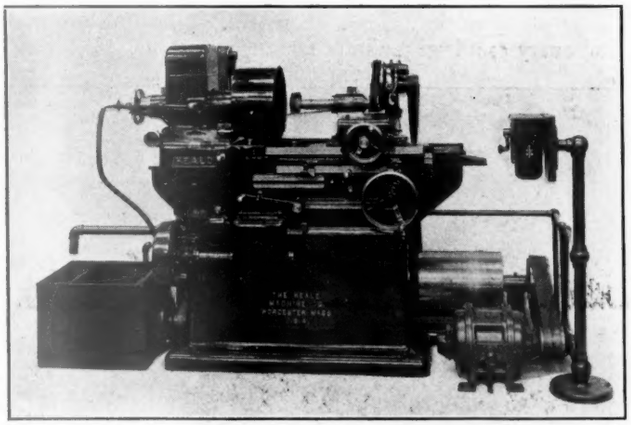
When the taper to be turned on a boring mill is so nearly horizontal that it is beyond the range to which the head can be swiveled, the transverse and vertical feeds are sometimes used together but this method is inconvenient. The correct setting of the swivel head must be obtained by trial but with the taper attachment the setting can be made directly.



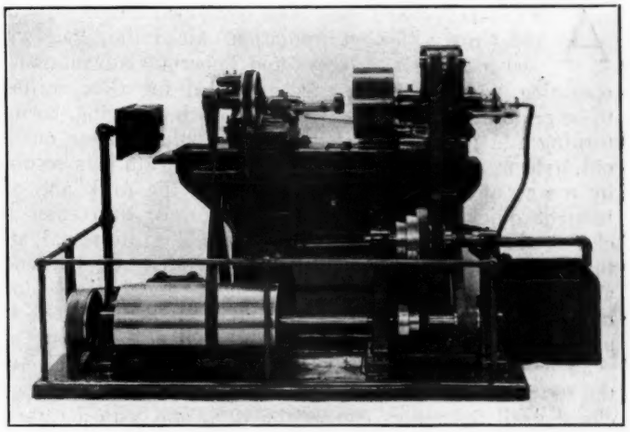
Cincinnati Taper Turning and Boring Attachment

New Motor Drive for Internal Grinder

WITH the idea of securing a more compact design, together with other advantages, a new motor drive unit for the Nos. 70 and 75 internal grinders has been designed by the Heald Machine Company, Worcester, Mass.



New Motor Drive for Heald No. 71 Grinder



Rear View Showing Drive Arrangement

The old solid idler is eliminated and a new flexible idler gives proper tension to the wheel-head belt, as well as the vertical belt between the drum and the idler.

There is a slight change at the head end where power is taken for the work head. A swinging arm is furnished which swivels on a bracket that holds the driving cones for giving the various speeds to the work head. The swinging arm is connected to the work head with a rod which is so fastened that it will allow swiveling the head either way and still keeping the proper belt tension. In other words, the rod acts as a distance feed. Providing the head has been swivelled around to a certain angle and the proper tension is not fur-

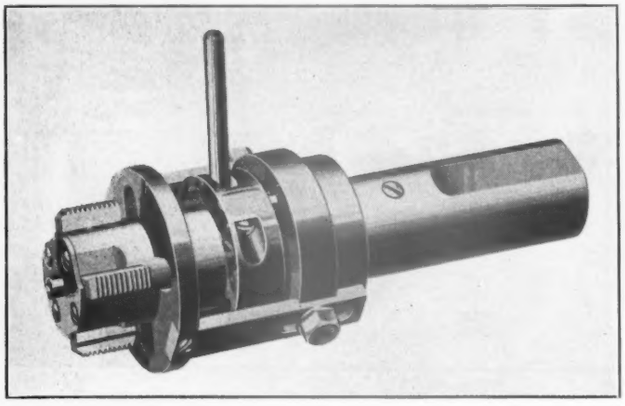
nished, the nut on this rod may be adjusted to give the proper tension.

Attachment of the new motor drive arrangement is very simple since it only requires moving the standard guard over the work-head pulley, replacing it by a box containing the idler pulleys.

Improved Automatic Collapsing Tap

AUTOMATIC collapsing taps are becoming more and more a necessity for threading operations and when introduced into railway shops, for example, will effect economies many times greater than their cost. Automatic taps are necessary because of the requirement for accurate work and as a safety feature to prevent spoiling work, but their greatest value lies in the greater production made possible.

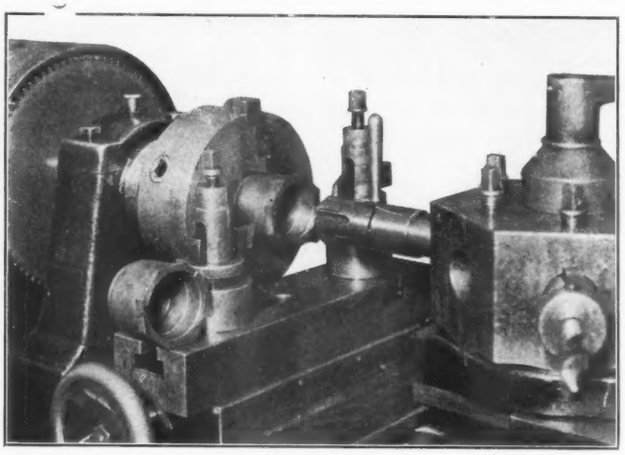
The National Acme Company, Cleveland, Ohio, has recently developed and placed on the market an improved automatic collapsing tap known as the Namco, which is designed



Namco Automatic Collapsing Tap

to fulfill the requirements stated above. The taps are provided with an inside trip, or outside trip, as illustrated, and can be furnished in all sizes for ordinary tapping operations. They are economical for use on general shop work because of their ease of adjustment and quick adaptability.

The illustrations show a general view of the tap and its use in a practical threading operation on a turret lathe. As



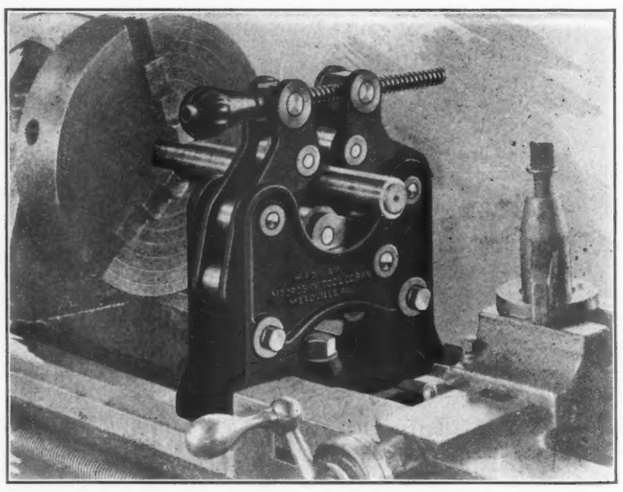
Collapsing Tap Used for Threading Operation on Turret Lathe

an example of its adaptability, an inside trip Namco tap can be equipped with a cammed tripping sleeve and reamer blades for reaming instead of standard chasers for thread cutting. While this is strictly special equipment, it shows the adaptability of the collapsing principle to smooth and positive collapsing action, as simple as throwing a gear out of mesh, and as positive.

Easily Applied Self-Centering Steady Rest

A STEADY REST has been developed recently by the McCrosky Tool Corporation, Meadville, Pa., with several special features and important advantages in operation. It is especially recommended for all operations to be performed on the end of a piece such as facing, boring, turning and practically all work that could be done on the old style steady rest. The self-centering feature is secured by means of three rollers which engage the work and are brought quickly and simultaneously toward the center by closing the jaws. The jaws are interacting, universal and therefore not independent. The three rollers are hardened and run on Hyatt roller bearings which reduces friction to a minimum. The power consumption is small and there are no contact points to wear off.

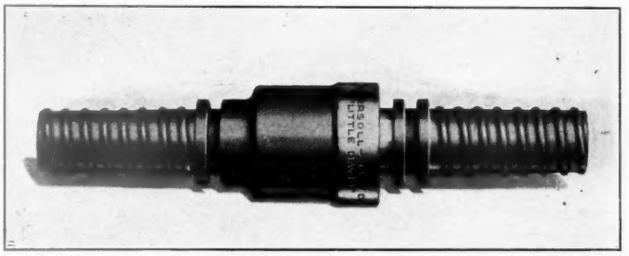
In operation the work is inserted in the lathe chuck and the steady rest placed in the desired position. The jaws are closed until the rollers engage the work and with a turn of the tightening screw, the machining operation may begin. Once adjusted to the lathe centers, the steady rest remains always adjusted and can be taken off and put on the lathe frequently in a few moments and without readjustment. A large range of diameters may be handled and the desired change made at any time without any adjustment except a few turns of the tightening screw. The No. 1 steady rest, illustrated, is designed for 12 to 18 in. lathes and has a range of 3/8 in. to 3 3/4 in. For soft, highly finished work, stationary cast iron jaws are recommended.



McCrosky Self-Centering Steady Rest

Hose Couplings for Pneumatic Tools

A HOSE COUPLING with several new and important features has recently been placed on the market by the Ingersoll-Rand Company, New York. It is called the "Little David" hose coupling and will be distributed as an accessory to the line of pneumatic tools manufactured by the Ingersoll-Rand Company. Hose couplings which become leaky after short use are the cause of serious air losses, whether in the small shop or the large plant using hundreds



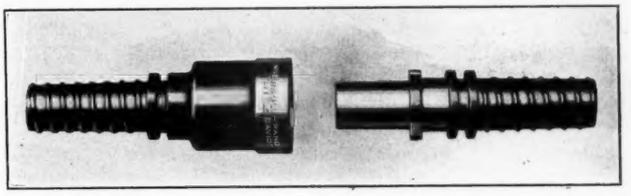
Little David Pneumatic Hose Coupling

of hose connections. Another trouble commonly experienced with many couplings is jamming or sticking through some slight injury, making them difficult or almost impossible to connect or disconnect.

The design of the new coupling has been made with the view to overcoming the above troubles. The main features claimed for it are sturdiness and simplicity, and an all around ability to stand lots of abuse without affecting its service. Actual tests over long periods of service have demonstrated its reliability. The coupling consists of two parts, male and female. The female end is fitted with a V-shape rubber gasket providing an air tight joint. The gasket is prevented from blowing out, should the coupling accidentally be disconnected under pressure, by a protective shoulder inside the coupling. The female end is exceptionally sturdy, there being no exposed parts which might be liable to injury and cause jamming or sticking.

The locking shoulders are heavy with large bearing surfaces, the locking spring being strong and durable. It can be replaced if necessary. The parts are made of a metal not subject to ordinary rusting or corrosion. The male end has a very liberal bearing in the female end, which assures alinement and long wear. Another feature is the absence of any outer sleeve exposed to injury. The air ports are straight and of uniform diameter, offering the least restriction to the flow of air.

The coupling may be connected or disconnected by a quar-



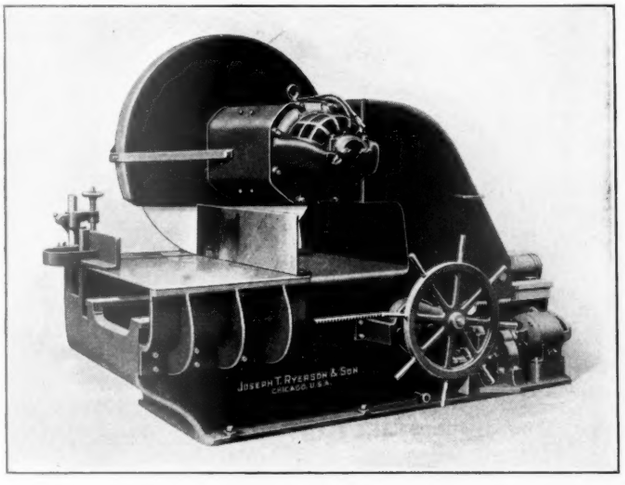
View of Coupling Parts Separated

ter turn. A groove in the hose end of each part allows using a hose clamp to attach securely to the hose.

These hose couplings are manufactured in ½ in. and ¾ in. sizes, which are interchangeable; that is, a ½ in. male piece may be used with a ¾ in. female end or vice versa. Gaskets are also interchangeable between the different sizes.

High Speed Friction Metal Cutting Saw

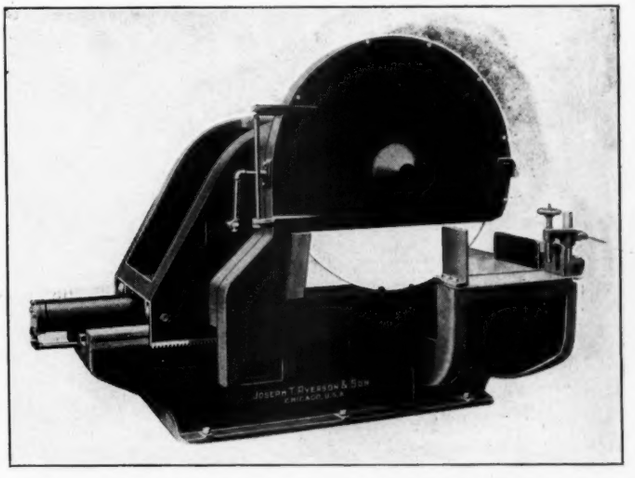
FOR the rapid cutting of structural steel shapes, the high speed friction saw, illustrated, has been developed recently by Joseph T. Ryerson & Son, Chicago. The machine consists of a heavy cast iron box base, on top of



Ryerson High Speed Friction Saw

which is mounted a horizontal rolling carriage. The carriage operates on roller bearings, mounted on eccentric pins to provide for adjustment. The hood is of heavy sheet metal construction, one side being hinged for greater ease in examining or removing the blade.

The blades are made of a special grade of soft steel, balanced, hollow-ground and nicked on the edge to increase the friction. Each blade is held in a carefully balanced collar and is cooled by jets of water directed against the cutting edge. Ample power is provided by means of an enclosed



View Showing Table Arrangement and Water Connections

motor, especially designed for heavy duty. In operation the saw blade is fed forward through the work by means of the hand wheel or by the electro-hydraulic feed. Power feed, when applied to the machine, is a complete unit consisting of an hydraulic cylinder and piston and a motor-driven pump. This feed is operated by a four-way valve conveniently located. Miter cutting is easily handled.

The new Ryerson friction saw is made in four sizes, similar in design and differing only in capacity. For shops handling lighter structural work, sizes No. 1 and 2 are recommended, with hand feed. For handling heavy structural work and work in railroad shops, sizes No. 3 or 4 are recommended, with power feed. Among the important advantages of this machine may be mentioned the fact that varying sizes and shapes of material can be cut in immediate succession without any adjustment of the machine. The work does not need to be clamped and the cutting operation is performed in a fraction of the time required by other means. The expense of operation is slight due to the entire absence of belts, fly wheels, etc., and the machine is easily operated by one man. From the standpoint of maintenance cost, the blades cost much less than slow speed saws and last longer.

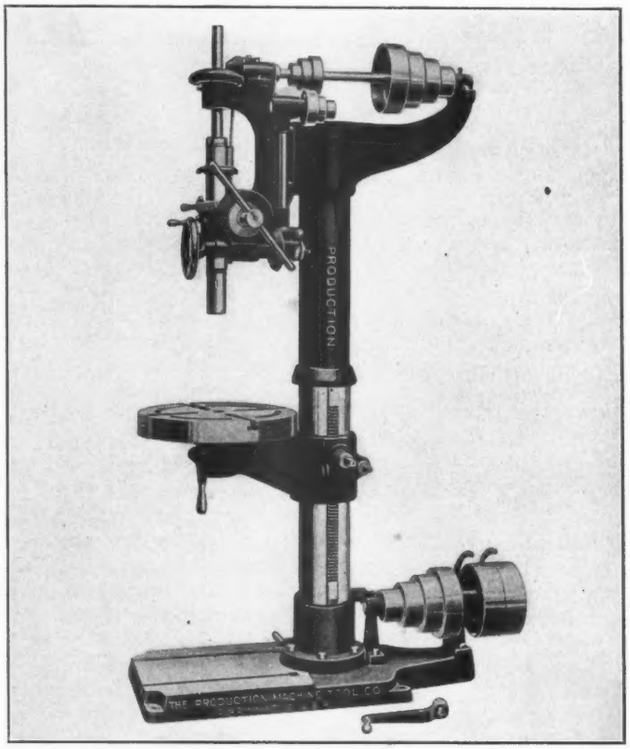
Twenty-Two Inch Drill With Stationary Head

THE Production Machine Tool Company, Cincinnati, Ohio, has recently developed and placed on the market a twenty-two inch upright drill with a stationary head and a capacity to drill, bore, tap, and ream holes up to and including 1¼ in. in diameter. This drill is bronze bushed throughout and the entire design is such as to make each part strong enough to withstand any ordinary strain to which it may be subjected. Centralized controls have been provided for convenience of operation and increased production.

The machine is regularly built with power feeds, but this feature may be omitted if desired. Back gears and tapping attachments can be added, together with the type of drive best suited to the conditions under which the machine is to be used; either regular tight and loose pulley, right angle or belted or geared motor drive. The unit system of construction has been followed throughout which eliminates individual fitting and assures interchangeability of parts. Bronze bushings are provided for all bearings and this prolongs the life of bearings in addition to facilitating the replacement when necessary. All details and units undergo a careful inspection and rigid test as to power before being assembled in the finished product.

The base of the machine is well ribbed and provided with T-slots, as is also the table. Clamping bolts are interchangeable and the radius slots in the table are especially convenient for some jobs. The table arm is of box construction in one casting, and has a wide bearing on the substantial tubular column. The drill head is of the box type with spindle driving gear bearing and head cast integral. This allows the spindle bearings to be bored and reamed at one setting with a resultant accurate alignment of the spindle.

The new drill is adapted for production work in assembly departments, as well as in jobbing and repair shops. Holes may be drilled to the center of a 22 in. circle. The spindle speeds when back gears are provided are 20, 33, 53 and 88 r. p. m. The spindle speeds without the back gears are 117, 196, 318 and 530 r. p. m. The power feeds per revolution of the spindle are .006, .010 and .105 in.



22-In. Stationary Head Production Drill

Lubricant for Locomotive Hub Liners

RAILROADS are constantly confronted with a great number of items of expenses which, seemingly small in themselves, total a large amount. One of these items is the expense resulting from the wear of locomotive hub liners. Failure properly to lubricate the various parts of locomotives, such as shoes, wedges, hub liners, etc., necessitates withdrawing locomotives from service and sending them to the shops on account of wear in excess of safe limits.

It is important to maintain driving box lateral play within specified limits and numerous devices have been invented and placed on the market to make it possible to remove driving boxes and reapply lateral liners without dropping the wheels. Much of this work can be eliminated, however, if the proper lubrication is applied in a systematic manner. Ordinarily a service of 30,000 miles may be expected before it is necessary to take up lateral play on driving boxes but in some cases where lubrication has been neglected the adjustment has to be made at the end of approximately 5,000 miles. Not only is the service of the locomotive lost for at least a day, but the operation itself is expensive and requires the time of several men.

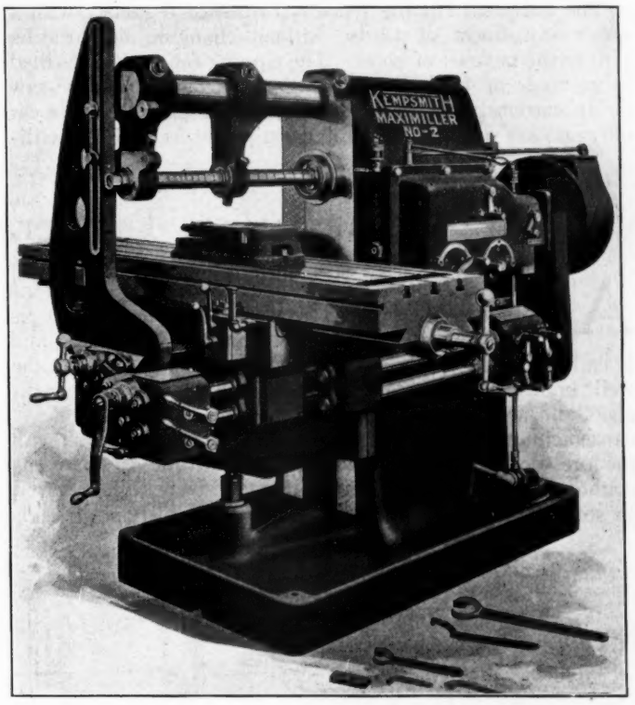
A lubricant known as Dixon's graphite hub liner grease has been developed by the Joseph Dixon Crucible Company, Jersey City, N. J., to be applied with a grease gun. It is claimed that this grease, properly applied, will greatly reduce the heating, wearing and cutting of working parts and lengthen the life between shoppings.

Plain Milling Machine for Medium Heavy Work

THE No. 2 plain Maximiller, illustrated, is a recent addition to the line of milling machines made by the Kempsmith Manufacturing Company, Milwaukee, Wis. The machine is practically the same in all points of design as the Kempsmith No. 4 plain Maximiller and is adaptable for medium heavy classes of work. The new machine is designed for maximum rigidity, convenience of operation and efficiency in production. All important parts have been carefully designed in regard to relative weight and strength. The sloping column lines not only add to the appearance, but are true lines of strength. The large area of the base provides stability for the entire machine. The knee is of the solid top design with no opening, a construction which serves to resist clamping strains and the torsional effect of the table overhang. The column is well ribbed internally and has only a few small openings. The saddle, as shown in the illustration, is long, heavy and rigid. Drive to the table is located near the end of the saddle, which leaves the center solid, where most of the strain comes. The table is 12 in. wide with 56 in. working surface length.

The drive pulley is 15 in. in diameter, takes a 3½ in. double belt and runs at 400 r. p. m. It is mounted on ball bearings and with the clutch is enclosed in a protected housing. The control levers are conveniently located and proper safety devices are incorporated throughout. The speed change mechanism provides 18 changes of speeds ranging from ⅝ in. to 25 in. per minute in geometrical progression. Power quick traverse is available for all table movements without disturbing the set-up for whatever rate of speed may be in use. The longitudinal power quick traverse is at the rate of 100 in. per minute, while the cross and vertical travel is at the rate of 36 in. per minute.

By means of a train of gears, 18 changes of spindle speed may be obtained ranging from 16 to 400 r. p. m. When desired and especially ordered, the machine can be arranged for motor drive through a belt, in which case the motor recommended is 7½-hp. running at 1200 r. p. m.

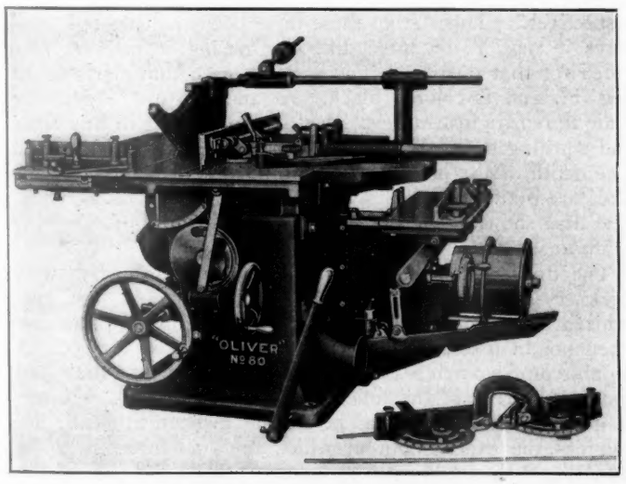


Kempsmith Plain Maximiller No. 2

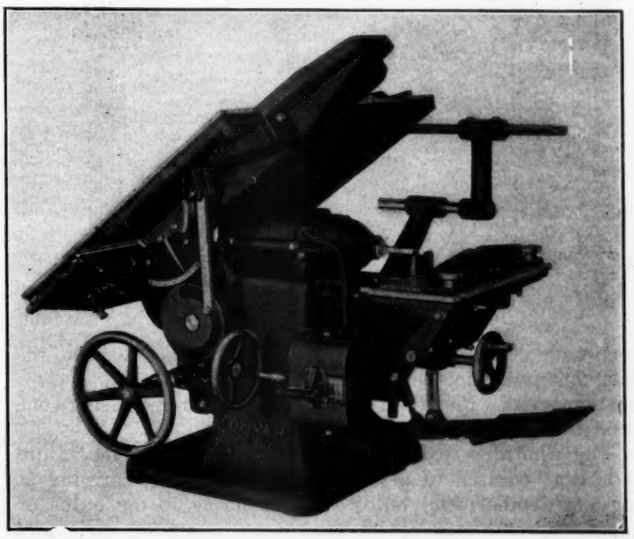
Belt or Motor Driven Variety Saw Bench

THE machine illustrated, which can be arranged for either belt or motor drive, has been designed by the Oliver Machinery Company, Grand Rapids, Mich., to do ripping, cross cutting and dadoing in an efficient and thorough manner. It will cut a practically perfect miter and measure any angle quickly and accurately. It will cut off to lengths or rip to width, all without the operator doing any calculating or referring to a rule. The machine is rigid and accurate and parts are interchangeable. A 14-in. saw is regularly supplied, although a 16-in. saw may be used. The machine is arranged with or without a mortising and boring attachment.

One of the valuable features of this saw bench is the table, which is 36 in. by 44 in., tilting to 45 deg. to the left. The table has vertical adjustment and may be furnished either



Oliver No. 80 Variety Saw Bench



Variety Saw Bench With Table Tilted

plain or universal. The universal table shown in the illustration has a rolling section which is located at the left of the saw and rolls on ball bearing ways having vertical adjustment for alinement and for wear. The table may be moved several inches from the saw, permitting the use of dado or special heads. This table is said to operate so easily that it is well suited for production work and multiple cuts.

The universal ripping fence is furnished regularly with a quick adjustment of 12 in. without changing the locating pins to the next set of holes. The ripping fence may be tilted to an angle of 45 deg. and is adjusted to and from the saw by an extremely accurate micrometer adjustment. Miter cut off gages are supplied as regular equipment as well as auxiliary rods and stops which are intended to be used with gages.

For motor drive, a motor operating at about 1800 r. p. m. is mounted on a subbase bolted securely to the machine and belted directly to the main driving belt, eliminating the necessity of a countershaft.

The machine will rip up to 23 in. wide and cut off 32 in. wide by the use of the universal ripping table; will rip 27 in. wide and cut off 15 in. wide by the use of the plain table; will cut up to 3 in. thick with a 14-in. saw, or 4 in. thick with a 16-in. diameter saw, and will work dados up to 4 in. wide. With mortising and boring attachment it will bore holes 6 in. deep up to 2 in. in diameter, and will mortise holes up to ¾-in. square and 4 in. deep.

Measuring Temperatures in Stored Coal

A NEW DEVICE for indicating the thermal conditions of stored soft coal has been placed on the market recently by F. C. Thornley & Co., Inc., New York, and is called the Thornley coalometer. Bituminous coal has the well known property of spontaneously heating in certain spots and at varying depths. This heating does not always cause actual combustion, in the sense that the coal burns with the presence of flame, although this condition is often encountered. There does exist almost universally, however, in stored coal of this character, a slow combustion which is even more destructive than combustion by flame, owing to the fact that it cannot be so readily detected. This slow combustion goes on unnoticed throughout an ever-increasing zone beneath the surface of stored coal.

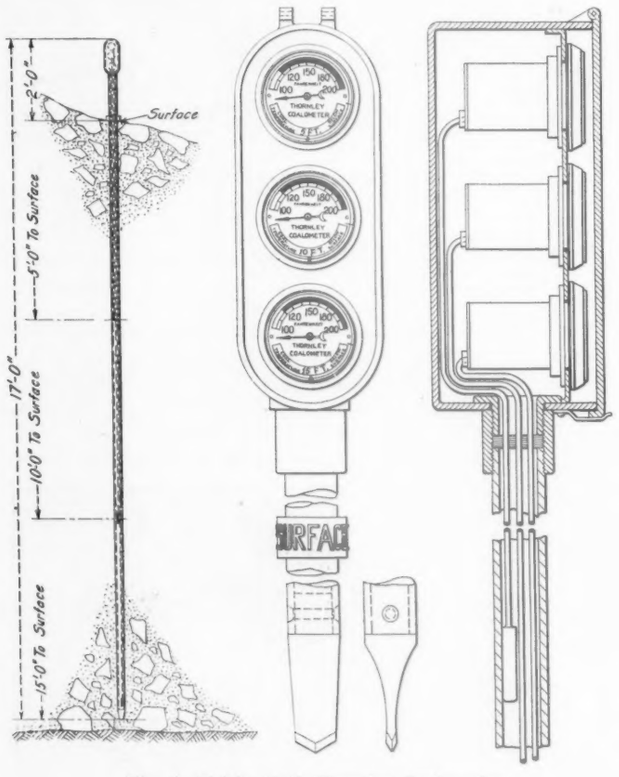


Fig. 1—Triple Unit Thornley Coalometer

The Thornley coalometer consists of a set of temperature indicators encased in a long pointed steel tube, carrying at varying depths metal bulbs (corresponding to the bulbs of thermometers), and at its upper end a set of dials and pointers, which indicate, under all atmospheric conditions, the exact temperature of the bulbs which actuate them. These units are forced down into the coal pile to definite depths and at various points, and collectively furnish definite data to the consumer as to the exact temperatures existing beneath the surface. If an accurate record of daily readings of these instruments is kept, the slightest rise in temperature is at once detected, and should it become excessive, the consumer can remove this particular portion of fuel, thus saving the greater part of the heating value of the coal which has started to dissipate.

Tests have shown that an installation of one coalometer each 50 ft. in both directions from its neighbor will efficiently indicate conditions of temperature below the surface. Thus the installation of one triple unit will protect approximately 900 tons of coal if the volume is about 50 ft. by 50 ft. by 16 ft.

A triple unit coalometer for use in coal piles from 15 ft. to 20 ft. deep is shown in Fig. 1. A galvanized steel tube, having a hardened steel diamond point drill at its lower end, carries three pressure bulbs at depths of 5, 10 and 15 ft., respectively. Tubes from these three bulbs register temperatures in deg. F. on three dials, by means of pointers provided for that purpose. The scale on each dial starts at 32 deg. F., and is colored black. At and above 120 deg. the scale is red, indicating excessive heat at a point in this zone, and warning the coal man to remove this portion of the coal. The depth of the hot spot is determined at a glance, for the dials are plainly marked 5 ft., 10 ft. and 15 ft., respectively. The dial showing the hottest temperature thus indicates the depth at which the heat is generating.

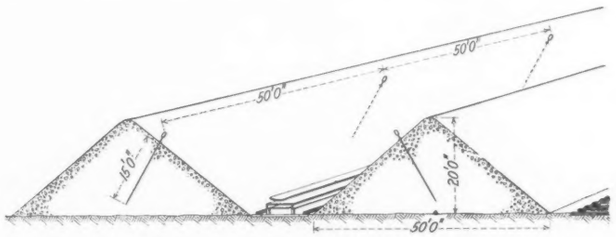


Fig. 2—Typical Installation of Coalometer

The dials are enclosed in weathertight metal cases with thick crystal faces, and the set is again enclosed in a galvanized cast iron case. This furnishes ample protection when not in use, and added protection when in service. A slidable pipe wrench is provided on each unit to aid the rapid and easy boring of the tube to the desired depth. A large, plainly-marked lug, 12 in. below the instrument head, determines the exact depth at which the coalometer is to be placed, and thus allows of no guess-work on the part of the man who does the installing. The construction throughout is

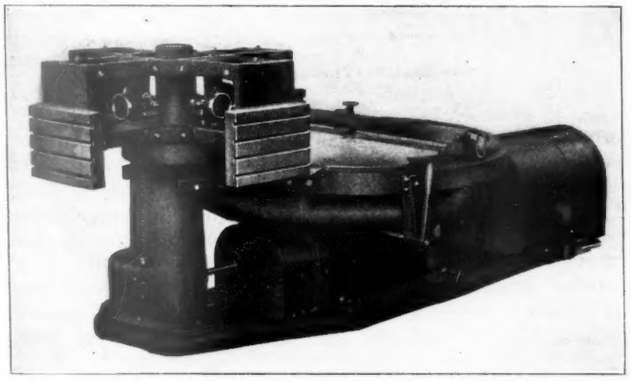
very rugged and will allow of the rapid removal and stacking of one or more units repeatedly, without fear of damage to the temperature indicators themselves. These indicators are especially constructed to indicate accurate temperatures under the varying conditions encountered throughout the year. They will indicate exact bulb temperatures regardless of the temperature of the head of the instrument, and will retain their calibration under conditions of extreme vibration or violent shocks. They are easily readable and amply protected from breakage in handling.

Thornley coalometer units are supplied in two lengths, 12 ft. and 17 ft., which carry, respectively, two and three temperature indicators, a typical installation being shown in Fig. 2. The indicated temperatures when taken daily and recorded furnish complete knowledge of conditions beneath the surface of the coal.

Continuous Feed Disc Grinding Machine

THE No. 24 grinder illustrated is made by the Gardner Machine Company, Beloit, Wis., and represents one of the latest developments in disc grinding machinery. It is a continuous feed disc grinder, being semi-automatic in operation and eliminating the labor expended in using the ordinary hand-operated machine. With any hand-operated machine, where the human element is the main factor in production, it is impossible to secure a uniform output all through the day. The operator grows tired and is certain to "let up a little" near the end of the day, thus affecting the total production possibly more than is realized.

The machine illustrated carries one horizontal disc wheel 54 in. in diameter and is provided with a revolving reel



Gardner No. 24 Continuous Feed Disc Grinder

which carries four work tables. The work to be ground is attached to these tables by means of suitable fixtures mounted on them, and the revolving wheel brings it over the surface of the grinding wheel. The tables are automatically lowered onto the wheel. Pressure, to assure quick removal of stock, is secured through gravity, but by means of a compression spring this pressure may be adjusted. The weight of the table provides application of a uniform pressure, which can be increased by adding extra weight if the character of the work necessitates it. A micrometer stop screw makes it possible to remove stock to definite dimensions which may be required.

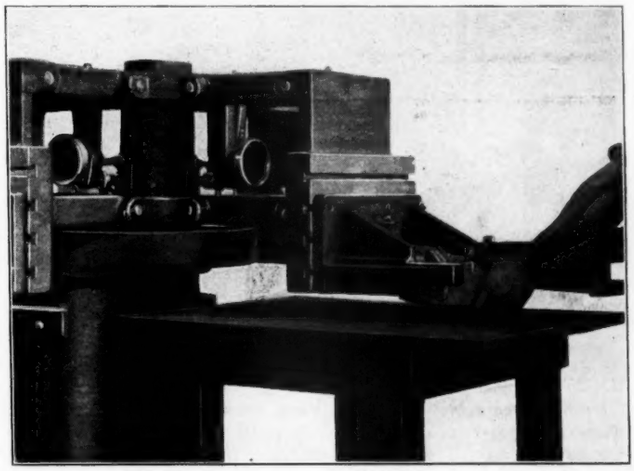
The revolving wheel is mounted on a vertical shaft of special piston rod stock 3½ in. in diameter, and is driven through worm, spur and bevel gears from the gear driving the main spindle of the machine. By means of change gears the reel may be made to revolve ¼, ½ or 1 r.p.m., thereby producing one, two or four finished pieces per minute. Other speeds, if desirable, may be obtained by substituting special gears.

The driving shaft is provided with a friction clutch, operated by a lever placed in a convenient position, which makes it possible to start or stop the feeding mechanism independently from the grinding wheel. The reel and the shaft which drives it are mounted in bronze bearings, all other shafts being carried in ball bearings. The gears are totally enclosed, which protects them from dust and dirt and allows them to be amply lubricated.

The feeding stand is bolted directly to the base plate upon which the machine is mounted and, to accommodate various sizes of work, has an adjustment of 6 in. along this base plate. Because the work tables are at right angles to the grinding wheel, accuracy of the work being ground is assured. A micrometer stop screw permits grinding to definite dimensions and also allows the grinding of a surface to a required relation with some other area on the piece. This is an important advantage.

Rigidity and strength are important features of this machine, which weighs about 7,600 lb. when crated for domestic shipment. The disc wheel is mounted on an extra large and heavy cast iron flange. The driving spindle is of large diameter and runs in two self-alining radial ball bearings. All down or end thrust is taken on a self-alining ball thrust bearing which contains ten 1¼ in. diameter balls. Power is transmitted to the disc wheel by hardened special steel bevel gears.

An extra pulley is mounted on the driving shaft for belting to an exhaust fan, which is set on the floor in back of machine. There is a dust channel cast into the base of the machine and an efficient dust exhaust system is provided. A



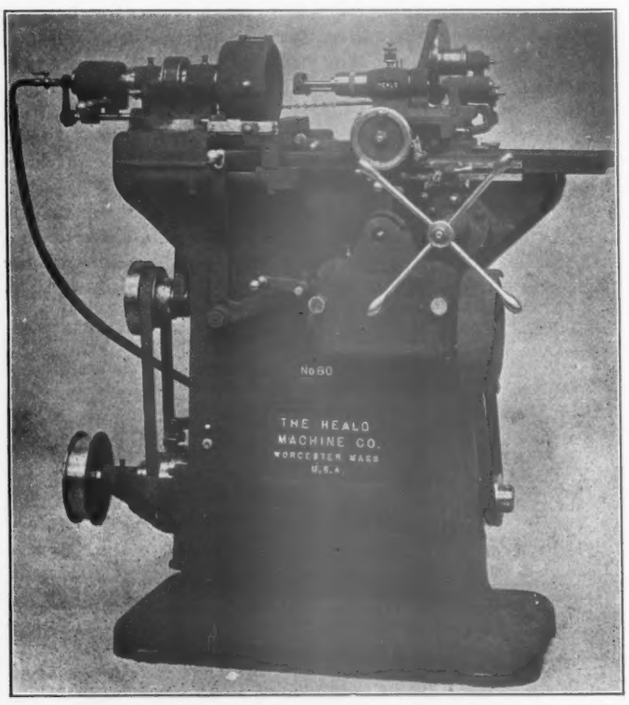
Method of Mounting Work Preliminary to Grinding

cast iron guard ring is fastened to the top of the base with collar head screws and any portion of the guard ring is removable, permitting the grinding of work carrying a lug projecting above the plane of the ground surface. The machine is adapted to a large variety of flat surface operations. It is provided with Gardner improved abrasive discs, a new type of abrasive structure reported to cut twice as fast as the old time glue bond circles, and to last from six to twenty times as long. They are recommended for use on the No. 24 continuous feed machine and increase its efficiency to a marked extent.

Power Feed Internal Grinding Machine

CAREFUL design and building of the style No. 80 internal grinder by the Heald Machine Company, Worcester, Mass., have produced a relatively massive, rugged machine for precision grinding of small work. It is modeled on the lines of the successful style No. 85 internal grinder, having all its mechanical features and, in addition, an automatic feed for the table, which is desirable for work of small diameter and longer than 1½ in. A unique feature of this machine is the vertical pinion for driving the table, which is equipped with a double friction. If only the hand feed for the table is required, throwing in the upper friction engages the pilot wheel, disconnecting the power feed, which is controlled by the lower friction, and the machine becomes suitable for production work on small, short holes.

Ordinarily, while the wheel is actually grinding, the power feed is used, but as the wheel leaves the work the operator, by pulling the vertical lever at the head end, disconnects the clutch operating the power feed to the table and engages one connecting the hand feed, allowing rapid hand movement of the wheel-head table out of the way. At the same time, automatically, a guard swings over the wheel, the water and

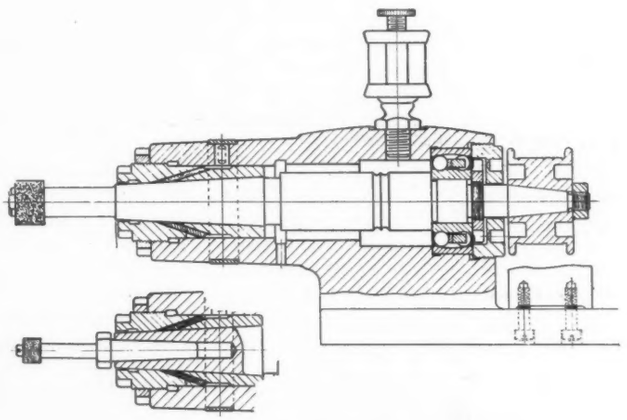


Heald No. 80 Power Feed Internal Grinder

work stop, making plugging or removal of the work instantly possible. The machine can be used to grind holes ranging from ¼ in. to 2 in. in diameter up to a maximum length of 3¾ in. The actual swing inside the water guard is 6 in., while without the guard, it is 10 in. The work-head is driven by a cross belt through the base from a cone giving three speeds of 160, 290 and 530 r.p.m. It is arranged to swivel and is graduated to 45 deg. or 4 in. taper per foot. The rotation of the work head and the pump is automatically and quickly stopped as the grinding wheel is drawn from the work.

The feed to the cross slide is calibrated to read to one-half thousandth of an inch on the diameter of the work. This can be operated by power or hand as desired. The main table has flat and V ways and is very rugged for this size machine. The travel of the table can be either by power, reversing accurately at any point desired or by hand feed with the power thrown out entirely. A two-step cone drive gives two speeds of travel with the power feed. The wheel head has a solid adjustable taper bearing at the wheel end with ball bearings at the pulley end.

Various holding fixtures have been designed and can be



Cross Section Through Wheel Spindle

furnished on order. The one usually supplied and giving the largest range consists of a quick acting collet chuck with jaws, having a capacity of ⅜ in. diameter up to 3 in. This is operated by a lever with an adjustable compensating device which prevents the work from being distorted from pressure. In railway machine shops, the Heald No. 80 internal grinder would be of particular value for such work as grinding hardened motion work bushings made in quantity to be carried in stock and later fitted to valve motion levers.

Fundamental Principles of Handling Men

In a talk to foremen published in Industrial Management, George D. Halsey lays down the following principles as requisite for securing best results in handling men:

1. Delegate and supervise the work.
2. Keep compensation fair and strictly proportional to output or general value to the company.
3. Study each individual carefully and fit the method of handling to the individual.
4. Make a careful sub-division of all duties based on a study of individual abilities.
5. Prepare careful and, wherever possible, written instructions showing just how each job should be done, and fair time in which to do it.
6. Plan and schedule your work carefully and always let the workmen see plenty of work ahead.
7. Co-operate with and use staff aids as much as possible.
8. Maintain proper dignity.
9. Endeavor, whenever possible without intruding, to lead your employees into habits of right and sound thinking and clean living.
10. Cultivate in yourself a real and unselfish desire to be of help to your employees.

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WE GUARANTEE that of this issue 10,200 copies were printed; that of the 10,200 copies, 9,240 were mailed to regular paid subscribers, 8 were provided for counter and news company sales, 260 were mailed to advertisers, 32 were mailed to employees and correspondents, and 660 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 10,200, an average of 10,200 copies a month.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The shops of the Southern Pacific at Houston, Tex.—the paint shop, air brake shop, storehouse and office—together with a number of cars, were badly damaged by fire on December 7. Estimated loss $350,000.

In the annual inspection of the Pere Marquette, Charles Montgomery, master mechanic at St. Thomas, Ontario, was awarded the prize of $100 offered by the railroad to the officer showing the highest grade on condition of shop, shop grounds, repair tracks and engine houses.

In order that the names of the American Railway Master Mechanics' Association and the Master Car Builders' Association, the two organizations now comprising the mechanical division of the American Railway Association, may be perpetuated, both are now being included on the circulars and other publications of the mechanical division. The names "Master Car Builders" and "Master Mechanics" appear directly under the formal name of the organization.

Since the introduction of welded steel pipe, the term "wrought pipe" has been used indiscriminately to denote both welded wrought iron and welded steel pipe. This has led to confusion as the average consumer of pipe is not familiar with the manufacturing processes. In order to avoid this confusion, the National Pipe & Supplies Association has recommended that the terms employed by the American Society for Testing Materials in differentiating between iron and steel pipe, viz., welded wrought iron pipe and welded steel pipe, should be accepted and adhered to.

Two of Chicago's leading technical institutes, with the cooperation of the American Society for Steel Treating, will offer evening courses in the subjects of forging and heat treatment of steel. These courses are specially planned for the benefit of the practical men in the forge shop or heat treating departments or those who wish to qualify for such work. The course will embrace the following phases of the work: pyrometer, microscope, forging, annealing, alloy steels (dealing with the effects of different alloys and treatments upon the physical characteristics of steel), hardening and drawing of tool steel and case hardening. The plan and formation of this course was carried out by the Chicago chapter of the society through their educational committee and its seven sub-committees. The texts, lectures and demonstrations were prepared voluntarily.

The Southern Pacific has just completed a motion picture depicting graphically the story of oil, tracing its history from production to consumption. The film will be shown at all terminals and at principal points of the system as an aid in teaching the conservation of this product, of which the Southern Pacific uses 60,000,000 gallons a month, or about 16 per cent of all oil produced in California. The company, in notifying its employees of the picture, states that there is a message to be learned by all who see this film. Further, that the fuel industry faces a crisis; that those who depend upon the industry must take heroic measures if they would stave off disaster and that the picture shows what these measures are. It is further stated that the consumption of fuel oil now exceeds production by 30,000 barrels a day and reserve stocks in California are being depleted by 1,000,000 barrels a month.

Freight Car Orders

The Louisville & Nashville has ordered 1,500 steel hopper cars of 55 tons capacity from the American Car & Foundry Company and 500 from the Mt. Vernon Car Manufacturing Company.

Locomotive Orders

The Missouri Pacific has ordered 50 locomotives from the American Locomotive Company, divided as follows: 25 Mikados, 5 Pacifics, 5 mountain type and 15 switchers.

The Rio Grande do Sul State Railway (Brazil) has ordered 20 Mikado type locomotives from the American Locomotive Company. These locomotives will have 16 by 22 in. cylinders and a total weight in working order of 110,000 lb. and will be equipped with superheaters.

The Missouri Pacific has ordered 15 switching, 5 Mountain type and 5 Pacific type locomotives from the American Locomotive Company. The switching locomotives will have 6 wheels, and cylinders 21 by 28 in., and a total weight in working order of 165,000 lb.; the Mountain type locomotives will have 27 in. by 30 in. cylinders, and a total weight in working order of 345,000 lb.; the Pacific type locomotives will have 26 by 26 in. cylinders, and a total weight in working order of 265,000 lb. All these locomotives will be equipped with superheaters.

Union Pacific Develops New Safety Organization

As a means of spreading the gospel of safe practice to all of its employees most effectively, the Union Pacific has reorganized its safety department. Heretofore this has consisted of a general safety agent, with three assistants, all of whom had concurrent jurisdiction, and also three mechanical safety inspectors located in the large shops. In place of this organization there is now a general safety agent with five division safety agents

and two shop safety inspectors. One division safety agent is assigned to each of the larger divisions, with one agent covering two divisions of lighter traffic. The two safety inspectors are assigned to the two larger shops, respectively, where they will supervise all operations, with a view to promoting safety, and also give safety lectures to each employee taken into the force before he is permitted to go on duty.

Another innovation covering the entire Union Pacific System, including the Union Pacific Railroad, the Oregon Short Line and the Oregon-Washington Railroad & Navigation Company, is a safety banner contest to be carried on for a period of one year, at the end of which time banners will be awarded on the basis of safety records made under the following conditions: (1) A banner to the system unit making the lowest record in casualties per one million locomotive miles. (2) A banner to one division on each system unit making the lowest casualty record per one million locomotive miles. (3) A banner to the one of the six large shops on the system, *i.e.*, Omaha, Kansas City, Denver, Cheyenne, Pocatello and Portland, making the lowest casualty record per 100 employees. Employees of the St. Joseph & Grand Island Railroad, which is a part of the Central Division of the Union Pacific, will be included in this contest. These banners will be awarded for a period of one year and at the end of the year following if another system unit or division on a system unit or one of the large shops on the system has made a better record in safety than that holding the banner for the preceding year, it will then be entitled to the banner for the ensuing year. It is expected that keen competition will be developed to win these banners and the result of this campaign is looked forward to with interest by the officers and employees of the Union Pacific System.

Mechanical Associations' Plan for Joint Exhibit

At a meeting of the official representatives of a number of minor railway mechanical associations and the associations of supply men exhibiting at the conventions of the railroad organizations, schedules were arranged for holding the conventions of a number of the associations at the Hotel Sherman, Chicago, during a continuous period of two weeks beginning September 6, 1921. The railroad organizations definitely committed to the plan are the Traveling Engineers' Association, the International Railway General Foremen's Association, the American Railroad Master Tinners', Coppersmiths' and Pipe Fitters' Association and the Chief Interchange Car Inspectors' and Car Foremen's Association. Others may possibly be included at a later date.

In order to carry out the details of the plan for conducting a continuous joint exhibit and to arrange for simultaneous meetings of some of the associations, a resolution was passed that a committee be organized consisting of a representative from each of the railway and supply associations interested, to take care of features of the arrangements which would not regularly be handled by the individual associations, and that this committee be prepared to present a report at a joint meeting to be held in September, 1921, recommending the form of a permanent joint organization, if such an organization seems to be desirable.

Shop Construction

ATCHISON, TOPEKA & SANTA FE.—This company is constructing 10 additional stalls at its enginehouse at Amarillo, Tex., each stall to be 120 ft. long. The company is also lengthening 12 of the present engine stalls from 92 to 102 ft. The construction is of concrete and will cost approximately $125,000.

CHESAPEAKE & OHIO.—This company will add 10 stalls to its engine house, install a new turntable, and erect an ice plant, storeroom and office building at Clifton Forge, Va., at an approximate cost of $600,000.

CHICAGO, INDIANAPOLIS & LOUISVILLE.—This company has awarded a contract for the construction of car repair shops at Lafayette, Ind., to A. E. Kemmer, Lafayette. The structure, which will have dimensions of 85 ft. by 440 ft., will be of brick and steel construction and will cost approximately $140,000.

DENVER & SALT LAKE.—This company is rebuilding its shops at Utah Junction, Colo., which were destroyed by fire, at a loss of $250,000.

MISSOURI, KANSAS & TEXAS.—This company has awarded a contract to H. D. McCoy, Cleburne, Tex., for the construction of a roundhouse, shop, storehouse, and roundhouse foreman's office at Oklahoma City, Okla. The company contemplates enlarging its roundhouse and car facilities at Osage, Okla.

NORFOLK & WESTERN.—This company is adding 16 stalls to its 24-stall engine house at West Roanoke, Va. The company is also adding 8 stalls to its engine house at Bristol, Va.

Land Slide Covers Pennsylvania Tracks at Pittsburgh

The operation of the Pennsylvania Railroad was seriously hampered during the month of November by a slide which for a time threatened to cover all the main line tracks. The failure of the retaining wall east of the Union Station allowed material which had been filled into a gulley to slide onto the tracks. The movement of the earth was gradual and measures were taken to excavate the material as fast as it slid onto the tracks. Eventually 9 large steam shovels, 2 small ditching machines, 120 40-yd. steel dump cars, 300 12- and 16-yd. wooden dump cars and about 500 gondola cars were used to keep back the slide. The maximum encroachment of the slide onto the railroad property occurred on November 22, when the toe of the slide extended 200 ft. from the mouth of the ravine. The main tracks were again placed in service on December 6.

Subjects for 1921 Convention—Traveling Engineers' Association

The list of subjects of committee reports to be presented at the 1921 annual meeting of the Traveling Engineers' Association, which has recently been issued, includes the following topics:

The Best Method of Operating Stoker Fired Locomotives to Obtain the Greatest Efficiency at the Least Expense; Joseph Kelley (L. V.), Chairman.

A Comprehensive Standard Method of Employing, Educating and Examining Engineers and Firemen; J. B. Hurley (Wabash), Chairman.

What Are the Advantages of the Self-Adjusting Wedges, the Feed Water Heater and Devices for Increasing the Tractive Power of the Locomotive in Starting and at Slow Speed; T. F. Howley (Erie), Chairman.

Subjects for Discussion: J. H. DeSalis (N. Y. C.), Chairman.

Distribution of Power and Its Effect on Operating Costs; Robert Collett (N. Y. C.), Chairman.

Recommended Practice for Conservation of Locomotive Appurtenances and Supplies; J. P. Russell (Southern), Chairman.

Railroad Wages in Need of Reform

Hon. George W. Anderson, of Massachusetts, judge in the United States District Court and former Interstate Commerce Commissioner, in a speech at Boston on Monday, November 29, denounced the present system of railroad wage rates as absurd and unjust, and called upon all interested to work for its correction. Speaking before a conference of commercial and railroad interests, called to take action to induce the Interstate Commerce Commission to "save the railroads and industries from ruination," threatened by the present financial condition of the roads, he condemned in strong terms "the absurd scheme of paying the same scale of wages all over the country, regardless of living conditions and of the amount of work required, to all men holding a job carrying the same name." He urged that inflexible standards of wages be abandoned, in the interests of the working men themselves, and characterized as absurd the labor unions' proposal to secure a standardization of working conditions. Labor must alter its policy in this matter, or the public must compel the Railroad Labor Board to alter it. It is a menace to the public interest.

The artificial standardization of wages, on a mere money basis, that is, regardless of money purchasing power in varjous sections and of the quantity and quality of service required of such employees as station agents and freight handlers in large overworked sections, as compared with the necessary labor at small stations in which the business is limited to two or three hours a day, cannot be justified.

Transportation of Explosives During 1918

During the year 1907, which immedately preceded the enactment of the act to promote the safe transportation in interstate commerce of explosives and other dangerous articles, etc., 79 accidents in the transportation of explosives resulted in 52 deaths, 80 personal injuries and a total known property loss of nearly $500,000. During the year 1918 our

military program required the production and transportation of more than 2,000,000,000 pounds of military explosives. In addition to this, the normal movement of explosives for commercial use amounted to about 600,000,000 pounds. It is deduced from careful estimates that at all times during the year 1918 there were on the tracks of the railroads in the United States not less than 55,000 carloads of explosives of an average weight of 40,000 pounds each. Notwithstanding the tremendous increase in the volume of these explosives transported during that year, the casualties resulting therefrom were only two persons injured and the damage to property was about $33,000.

In the transportation of dangerous articles other than explosives, however, 1,204 accidents occurred during 1918, resulting in 17 persons killed, 86 persons injured, and a known property loss of approximately $1,300,000. The remarkable success in transporting explosives is attributed to the penal provisions of the act of March 4, 1909, and the enforcement thereunder of our regulations governing such transportation. —From the Annual Report of the Interstate Commerce Commission.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI.—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eisenman, 154 E. Erie St., Chicago.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Meeting second Tuesday in each month except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York. Next meeting January 14. Film pictures of Baldwin Eddystone plant will be shown and an explanatory address given by A. H. Ehle, general sales manager.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November, Hotel Sinton, Cincinnati, Ohio.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 715 Clarke Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East 51st St., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention May 23 to 26, 1921, inclusive, Planters' Hotel, St. Louis, Mo.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting, January 11. Paper on the Service of Supply will be presented by H. C. Pearce, general purchasing agent, Seaboard Air Line.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in month except June, July and August, American Club House, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday in month except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Buffalo, N. Y.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard. Next meeting January 17, 1921. Paper on Cause of the Present Condition of Freight Cars and Suggestions for Their Improvement will be presented by J. C. Fritts, master car builder, D. L. & W.

PERSONAL MENTION

GENERAL

H. B. SMITH has been appointed fuel agent of the Kansas City Southern, with headquarters at Kansas City, Mo., succeeding B. B. Brain, who has been promoted to purchasing agent.

H. L. WORMAN, assistant superintendent of motive power of the St. Louis-San Francisco, has been appointed superintendent of motive power, with headquarters at Springfield, Mo., succeeding C. C. Higgins, deceased. Mr. Worman was born at Salem, Ohio, July 19, 1877. He entered the service of the St. Louis-San Francisco in 1905 as a machinist in the shops at Kansas City, Mo. In 1906 Mr. Worman was appointed roundhouse foreman at Kansas City. In 1907 he became erecting foreman and in 1908 machine foreman in the same shop. In 1911 he was appointed general foreman at Fort Scott, Kan., and in 1916 he became traveling roundhouse foreman for the entire system. In 1917 he was appointed master mechanic at Memphis, Tenn. In 1919 he was appointed assistant superintendent of motive power, with headquarters at Springfield, Mo., which position he held at the time of his recent promotion.

H. L. Worman

EUGENE R. GORMAN, superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn., was born on December 3, 1879, at Gorman Town, Minn. He entered railway service in April, 1900, as a locomotive fireman on the Chippewa Valley & Northern, a road owned and operated by the Arpin Hardwood Lumber Company, Bruce, Wis. In September, 1901, he became a locomotive fireman on the Western division of the Chicago, St. Paul, Minneapolis & Omaha. He was promoted to engineman and transferred to the Northern division in February, 1907, but left the company's service in May, 1908, to go with the Northern Pacific, working out of Missoula, Mont. In May, 1912, Mr. Gorman was appointed traveling engineer on the Northern division of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Spooner, Wis., and served in this position until December, 1915, when he was promoted to trainmaster on the same division. In May, 1917, he was made acting assistant superintendent of the Western division, with headquarters at St. James, Minn., this temporary promotion being made permanent in November, 1917. At the time of his recent promotion, Mr. Gorman was assistant superintendent of the Eastern division, with headquarters at Eau Claire, Wis., where he had been transferred in April, 1919.

Eugene R. Gorman

Alfred A. Klein has been appointed lubrication supervisor of the Santa Fe at Richmond, Cal., and will be directly under C. T. Ripley, general mechanical supervisor. Mr. Klein is one of the Santa Fe machinist apprentices graduated several years ago at the Topeka shops and has served in various capacities. During the last two years he was apprentice school instructor at Richmond.

Captain H. P. M. Beames has been appointed chief mechanical engineer of the Crewe Works and the hydraulic department of the London & North Western Railway, with offices at Crewe, England, succeeding C. J. Bowen Cooke, deceased. Captain Beames entered the Crewe Works as an apprentice in January, 1895, and, after his elementary training, held numerous positions of responsibility in the chief mechanical engineer's department, becoming locomotive works manager in April, 1916. At the outbreak of the South African war, he volunteered and served as a private, later becoming a sergeant. When the European war broke out, he again volunteered for military service and was given a command in the Royal Engineers, returning later to his position at the Crewe Works.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. A. George was appointed master mechanic of the Jacksonville Terminal, effective December 10.

H. G. Bonney has been appointed assistant master mechanic of the Lehigh & New England, with headquarters at Pen Argyl, Pa., succeeding N. R. Wright, resigned.

L. C. Tyler has been appointed road foreman of engines of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Urbana, Ill., succeeding Charles McCarty, transferred.

H. C. Gillispie, master mechanic of the Chesapeake & Ohio, with headquarters at Peru, Ind., has been transferred to a similar position at Huntington, W. Va., succeeding W. S. Butler, promoted. E. R. Woody, assistant master mechanic at Fulton, Va., succeeds Mr. Gillispie as master mechanic at Peru.

J. W. Lemon, master mechanic on the Central Kansas division of the Missouri Pacific, with headquarters at Osawatomie, Kan., has been transferred to the Colorado division, with headquarters at Hoisington, Kan., effective December 15. S. L. Landis has been appointed acting master mechanic succeeding Mr. Lemon.

W. M. Green has been appointed road foreman of engines of the Big Sandy division of the Chesapeake & Ohio, with headquarters at Paintsville, Ky., succeeding D. S. Baals, resigned. W. A. Mordica has been appointed road foreman of engines and assistant trainmaster, Shelby coal district, with headquarters at Shelby, Ky.

CAR DEPARTMENT

F. O. Erickson has been appointed car foreman of the Chicago, Rock Island & Pacific at Manly, Ia., succeeding M. B. Flaherty, who has been transferred.

J. W. Johnston, chief inspector of car lighting of the Canadian National, with headquarters at Toronto, has had his jurisdiction extended to include the Grand Trunk Pacific.

J. Gutteridge, foreman of the car department of the Kansas City Southern at Pittsburg, Kan., has been appointed general foreman, car department, with headquarters at Pittsburg, with jurisdiction over the entire line. C. E. Oakes has been appointed shop superintendent at Pittsburg, succeeding William Turley, resigned.

SHOP AND ENGINEHOUSE

L. E. Fletcher, master mechanic on the Atchison, Topeka & Santa Fe, with headquarters at La Junta, Colo., has been promoted to superintendent of shops, with the same headquarters. G. M. Lawler succeeds Mr. Fletcher.

Francis P. Howell, whose appointment as shop superintendent of the Atlantic Coast Line at Waycross, Ga., was announced in the December issue, was born on October 11, 1876, at Tarboro, N. C. He received a high school education and entered the employ of the Atlantic Coast Line on April 11, 1896, at Rocky Mount, N. C., as a machinist apprentice. In April, 1902, he was promoted to night roundhouse foreman; in May, 1903, appointed gang foreman; and in March, 1908, promoted to erecting shop foreman. In January, 1909, he was transferred as erecting shop foreman to Waycross, and in July, 1917, was promoted to general foreman. In July, 1918, he became master mechanic, with headquarters at Savannah, Ga., which position he held at the time of his recent appointment.

Clarence W. Adams, whose appointment as shop superintendent on the Michigan Central at Jackson, Mich., was announced in the December *Railway Mechanical Engineer*, was born on March 17, 1885, at St. Thomas, Ont. He attended the Collegiate Institute and entered the service of the Michigan Central on September 1, 1902, as a machinist apprentice. After finishing his apprenticeship in 1906, he was employed by the Pere Marquette, and also by the Burroughs Adding Machine Company, Detroit. In October, 1907, he returned to the Michigan Central at St. Thomas as a machinist. In 1912, he was promoted to gang foreman and erecting foreman; in 1916, enginehouse foreman; and finally, general foreman of shops and enginehouse, which position he held at the time of his recent appointment.

PURCHASING AND STOREKEEPING

J. B. Fowler has been appointed division storekeeper on the Pennsylvania, with headquarters at Fort Wayne, Ind.

H. W. Concannon has been appointed division storekeeper of the Salt Lake division of the Southern Pacific, with headquarters at Ogden, Utah, succeeding S. J. DeGraff, assigned to other duties.

F. Osterman, chief clerk of the purchasing department of the Chicago Great Western, has been appointed assistant purchasing agent of the Pere Marquette, with headquarters at Detroit, Mich.

L. Lavoie, assistant general purchasing agent of the Canadian National, with headquarters at Toronto, has been appointed general purchasing agent, with the same headquarters, succeeding E. Laugham, who is retiring from active service.

H. P. Buchenery, assistant division storekeeper of the Southern Pacific, with headquarters at Sparks, Nev., has been promoted to division storekeeper, with headquarters at Tracy, Cal., succeeding V. R. Taylor, transferred to Tucson, Ariz. J. F. McAuley succeeds Mr. Buchenery.

B. B. Brain, whose appointment as purchasing agent of the Kansas City Southern was noted in the December issue, entered railway service in 1885 with the Kansas City, Fort Scott & Memphis (now a part of the St. Louis-San Francisco). In 1902 he went to the Kansas City Southern as general storekeeper, with headquarters at Kansas City. Later he served as chief clerk in the purchasing department and, since 1912, has been fuel agent for the company, which position he held at the time of his recent appointment.

G. W. Bichlmeir, purchasing agent of the Kansas City Southern, has been appointed purchasing assistant of the Union Pacific, with headquarters at Omaha, Nebr. Mr. Bichlmeir was born at Cincinnati, Ohio, September 10, 1886, and entered the employ of the Cincinnati, Hamilton & Dayton in 1906 as a clerk in the office of the purchasing agent. In 1909 he became a clerk in the department of supply of the Missouri Pacific at St. Louis, Mo., and the following year was appointed chief clerk to the division storekeeper at Osawatomie, Kan., where he remained until January, 1911, when he became chief clerk to the general storekeeper of the Kansas City Southern. He remained in this position until 1917, when he resigned to engage in business. In April, 1918, he again entered the employ of the Kansas City Southern as chief clerk to the purchasing agent, and in August of the same year was appointed assistant to the purchasing agent. Mr. Bichlmeir was appointed purchasing agent of the Kansas City Southern in March, 1920, and was holding that position at the time of his recent appointment.

OBITUARY

C. J. Bowen Cooke, chief mechanical engineer of the London & North Western, died October 19. Mr. Bowen Cooke entered the Crewe works of the London & North Western as a premium apprentice in February, 1875, and in 1880 was appointed assistant to the superintendent of the running department for the southern

division. In 1899, when the running departments of the London & North Western were put under one jurisdiction, he became assistant superintendent for the southern division, which position he held until June, 1909, when he was appointed chief mechanical engineer.

ROBERT SPEER MILLER, master car builder of the New York, Chicago & St. Louis, died suddenly of heart failure at his home at Cleveland, Ohio, December 1. Mr. Miller was born in Washington county, Pennsylvania, September 13, 1856. He entered railway service in 1879 with the Pittsburgh, Cincinnati, Chicago & St. Louis as a rodman in the engineering department. In 1882 he entered the service of the New York, Chicago & St. Louis, and subsequently served as foreman, general car inspector and master car builder of the same road, which latter position he held at the time of his death.

H. J. SMALL, for many years general superintendent of motive power and machinery of the Southern Pacific, died October 28, at Berkeley, Cal. Mr. Small was born at Cobourg, Ont., November 15, 1849, and was educated at Toronto Normal School. He entered railway service in 1868 as a machinist on the Chicago North Western. A year later he became a draughtsman for the Kansas Pacific (now a part of the Union Pacific), which position he resigned in 1871 to become chief draughtsman for the Northern Pacific. In 1873 he went to Texas to become a general foreman on the International & Great Northern, which position he held until 1877, when he became master mechanic for the Galveston, Houston & Henderson. He left this position in 1879 to become master mechanic on the Texas & Pacific. In 1881 he was appointed superintendent of machinery of the Northern Pacific, and in 1887, assistant superintendent of motive power of the Philadelphia & Reading. Mr. Small became superintendent of motive power and machinery of the Southern Pacific in 1888, and, in 1902, was appointed general superintendent of motive power and machinery. He remained in this position until 1915, when he retired on account of ill-health.

H. J. Small

Railway Accidents in the United Kingdom During 1919

The Ministry of Transport recently issued a report on the accidents which occurred on the railways of the United Kingdom in 1919. There was a total of 932 people killed, as against 870 in 1918, while the number of persons injured last year totaled 23,983. Of accidents in which the movement of trains and railway vehicles was not concerned, only the fatal cases were required to be reported in 1918, so that a comparison under that head is not possible. The number of killed in 1919 included 361 trespassers—comprising suicides—and 318 servants of companies or contractors met their deaths by accidents in which the movement of trains was concerned. There were 827 persons killed and 5,897 injured during the year in accidents caused by the movement of trains and railway vehicles (exclusive of train accidents). Twenty-seven passengers were killed and 810 injured by falling between trains and platforms or on to platforms, ballast, etc., when attempting to enter or alight from trains, nine were killed and 13 injured when crossing lines at stations, 28 were killed and 76 injured by falling out of carriages during the running of trains, and 10 were killed and 927 injured from other causes.

There were 28 collisions during 1919, and of a total of 30 cases of train accident 10 were ascribed to the failure of enginemen to obey danger signals.

SUPPLY TRADE NOTES

George Baker, formerly general sales manager for the Illinois Steel Company, Chicago, who retired from active service about two years ago, died on November 18.

The General Railway Devices Company has been organized at Racine, Wis., with W. H. Osborne, president, John G. Osborne, vice-president, and W. V. Osborne, secretary and treasurer.

James C. Carlton, formerly connected with the Thompson Machinery Company, Pittsburgh, Pa., has entered the employ of the sales department of the Sherritt & Stoer Company, Philadelphia.

P. V. Burwell, who has been acting as an assistant for the advertising manager of the Black & Decker Manufacturing Company, Baltimore, Md., has been appointed assistant advertising manager.

The Air Reduction Sales Company, New York, has just completed building a four-story addition to its apparatus plant, Jersey City, N. J. It is of brick construction with reinforced concrete floors.

Edward Buker has been appointed representative of the car seat department of the Heywood Brothers & Wakefield Company, Wakefield, Mass., with office and exhibits at 1415 Michigan avenue, Chicago.

The Bastian-Blessing Company, Chicago, Ill., manufacturer of Rego oxy-acetylene and oxy-hydrogen products, has appointed the Beck-Hill Corporation, 22 Thames street, New York, as its sole eastern railway representative.

C. A. Eggert, who was for a number of years connected with the sales department of the Consolidated Car Heating Company, Albany, N. Y., has entered the employ of the O. M. Edwards Company, Inc., as sales manager, at 1425 Edison building, Chicago, Ill.

C. B. Merrell, who has been for a number of years in the general offices of the Economy Fuse & Manufacturing Company, Chicago, has been appointed district sales manager of its Philadelphia office, 523 Widener building, vice E. J. Watson, resigned.

J. C. Kopf, formerly manager of the engineering department of the Duff Manufacturing Company, has been appointed research engineer and placed in charge of a newly established research department. F. W. Schwerin has been promoted to manager of engineering.

A report has been published in some trade papers that the operation of the foundry of the Modern Steel Casting Company, Milwaukee, Wis., had been suspended because of a fire. The company states that this report is not true, as the damage was slight and the foundry is running at normal capacity.

A. E. Smith has been elected a vice-president of the Union Tank Car Company in charge of the construction and maintenance of plant and equipment. Mr. Smith will handle all correspondence regarding repairs to cars and M. C. B. matters. The office of master car builder has been discontinued.

The consolidation of the Whiting Foundry Equipment Company, of Harvey, Ill., and the American Foundry Equipment Company, of New York, as announced in the October issue, has not been consummated, and the two companies will continue to operate as separate concerns the same as heretofore.

H. G. Keller, manager of the Philadelphia, Pa., office of the Independent Pneumatic Tool Company, Chicago, has been promoted to manager of the New York office and F. H. Charbono, manager at St. Louis, Mo., has been promoted to manager of the Philadelphia office to succeed Mr. Keller.

P. C. Cady, who was for several years with the mechanical engineering department of the New York Central, has opened an office at 133 Greenwich street, New York, and will represent the following concerns: Guilford S. Wood Company, Chicago; J. Faessler Manufacturing Company, Moberly, Mo.; Coale Muffler

& Safety Valve Company, Baltimore, Md.; W. C. Dunn Company, Cincinnati, Ohio, and the Virginia Equipment Company, Oak Harbor, Ohio.

Ethan Viall, who for ten years served as an editor on the staff of the American Machinist, has resigned to take over the management of a middle-western manufacturing plant in which he has been interested. Mr. Viall's place has been taken by H. K. Condit, the former managing editor, and L. C. Morrow succeeds Mr. Condit.

The Falls Rivet Company, Kent, Ohio, has bought from the Ohio Wire Goods Manufacturing Company, Akron, Ohio, all its machinery, patents and patterns relating to the manufacturing of cotter pins and flat spring keys. The machinery has been moved from Akron to Kent and is now in operation. Lawrence Kneifel, of the organization at Kent, has become associated with the Falls Rivet Company.

Bruce Hartman, of Bloomsburg, Pa., a director of the Bell Locomotive Works, has been appointed receiver of the company by Federal Judge Witmer at Sunbury, Pa. The company's office is at 23 Water street, New York, and its works are at Bloomsburg. J. S. McCormack, sales manager, and William Stevenson, chief engineer, in the New York office, will probably remain with the company under the receiver.

Richard Sanderson, manager of the New York office of the Baldwin Locomotive Works and the Standard Steel Works Company, Philadelphia, Pa., has been transferred to Philadelphia as vice-president in charge of sales of the Standard Steel Works Company, succeeding Robert Radford, resigned. Mr. Sanderson was born on July 30, 1888, at Lynchburg, Va., and was educated at Worcester Polytechnic Institute, leaving there in 1910. He started as an apprentice on the Seaboard Air Line, later finishing his apprenticeship at the Baldwin Locomotive works. In 1912 he entered the New York office as assistant representative of the sales department for both the Baldwin Locomotive Works and the Standard Steel Works Company, remaining in that capacity until April 1, 1919, when he was made manager of the New York office for both companies. On December 1 he was elected vice- president of the Standard Steel Works Company, as above noted.

R. Sanderson

The Chicago Pneumatic Tool Company announces the appointment of J. F. Huvane as eastern manager of compressor and engine sales, with headquarters at 6 East Forty-fourth street, New York, and G. C. VandenBoom as western manager of compressor and engine sales, with headquarters at 300 North Michigan boulevard, Chicago. H. L. Dean, formerly manager of the compressor and engine sales division, has resigned.

The following companies have been appointed representatives of the Pneumatic Safety Valve Company, Woonsocket, R. I.; Frank E. Harrison, 56 Pine street, New York; the R. C. Neal Corporation, 76 Pearl street, Buffalo, N. Y.; the Sixt & Day Company, Guardian building, Cleveland, Ohio; Midgley & Borrowdale, 1550 McCormick building, Chicago, Ill., and the Charles A. Dowd Sales Company, 320 Market street, San Francisco, Cal.

Mr. Pasley, metallurgist, and Mr. Clowes, a mill production man, of Samuel Osborn & Co., Ltd., Sheffield, England, who have been visiting various plants in the United States and Canada making a study of American conditions and requirements, have returned to England. Their visit followed that of Arnold Pye-Smith, the London director, who was here during the summer for about five weeks. B. M Jones & Co., Inc., is the American representative of Samuel Osborn & Co.

S. C. Wilson has been appointed sales engineer in the Pittsburgh, Pa., office, 1224 Fulton boulevard, of the Whiting Foundry Equipment Company, Harvey, Ill., succeeding C. H. Martin. Mr. Wilson for the past year and one-half has served at the main office and works of the company. J. D. James, who has been with the Whiting company for the past eleven years, serving in various capacities, has been appointed assistant to George F. Crivel, the company's representative at 430 Ellicott Square, Buffalo, N. Y.

The Dunbar Manufacturing Company announces that the corporate name of the firm has been changed to the Morton Manufacturing Company. H. U. Morton is president; H. H. Schroyer, vice-president, and Charles D. Morton, secretary and treasurer. The factory and general offices are situated at 5133-39 W. Lake street, Chicago, as formerly. Among the railway appliances handled by this company are vestibule diaphragms (canvas and steel), steel doors for passenger and baggage cars, Chanarch steel flooring, car window curtains and fixtures, curtain rollers, sash locks and racks.

Harry U. Morton

Harry U. Morton, president of the Morton Manufacturing Company, entered railway service with the Pullman Company in 1891. He served this company for 4 years in the manufacturing department, and 13 years in the operating department. In 1907, he was appointed vice-president and general manager of the General Railway Supply Company, and seven years later became vice-president and secretary of the Acme Supply Company, Chicago. The corporate name of this company was changed to the Dunbar Manufacturing Company in 1917, and on April 1 of that year Mr. Morton was elected president and treasurer of the company. Charles D. Morton is the son of H. U. Morton. He is a graduate of the University of Wisconsin, class of 1917. He entered service with the company immediately upon receiving his discharge from the army in January, 1919.

C. D. Morton

The Toledo Crane Company, with main office and works at Bucyrus, Ohio, chartered in Ohio, with a capital of $500,000, succeeds the Toledo Bridge & Crane Company, of Toledo, Ohio, as builders of Toledo cranes. The new company has bought all drawings, patterns, records, and every item pertaining to the crane business. W. F. Billingsley, who for the past 11 years has been active in the management of the crane department for the Toledo Bridge & Crane Company, holds an executive position and is active in the management of the new company and has with him intact the present crane department organization of the Toledo Bridge & Crane Company.

H. W. Jacques, for the past six years manager of the railway supply department of the Simmons Hardware Company, St. Louis, Mo., has left the service of that company and has established an office at 404 Parkway building, Philadelphia, Pa. He will represent in the railroad field the following firms: Baldwin Tool Works, Parkersburg, W. Va.; Fayette R. Plumb, Inc., Philadelphia, Pa.; Columbus Handle & Tool Company, Columbus, Ind.; American Handle Company, Jonesboro, Ark.; Keller & Tamm Manufacturing Company, St. Louis, Mo.; Western Tinware Company, St. Louis, Mo.

James C. Currie, eastern representative of the Nathan Manufacturing Company, New York, was killed in an elevator accident in New York City on December 11. Mr. Currie was born in Scotland 69 years ago and came to the United States when he was 12 years of age. Shortly afterwards he entered the service of the Pennsylvania Railroad as a fireman and later served as engineman on the Congressional Limited. About 26 years ago he went to the Nathan Manufacturing Company as its eastern representative and was with that firm until his death. Mr. Currie was well known in the railway supply field and was assistant grand chief of the Brotherhood of Locomotive Engineers.

Don L. Clement will again represent Pratt & Lambert, Inc., Buffalo, N. Y., in the railroad field, with headquarters in New York. Mr. Clement represented Pratt & Lambert, Inc., in a like capacity until November, 1917, when he was commissioned in the Engineer Corps of the United States Army, and was immediately assigned to the 35th Engineers, a unit organized for the purpose of erecting railroad cars in France. He was overseas 16 months, and during the greater part of this time was assistant adjutant and adjutant of the 35th Engineers, which eventually became one of the grand divisions of the Transportation Corps. He was discharged in May, 1919, with the rank of captain. Since Mr. Clement's return to civilian life, he has been connected with Pratt & Lambert, Inc., on inside work of a special character.

The American Malleable Castings Association inaugurated a research program in 1915 to improve the works' practice of the member companies and insure a uniform high-grade product. The improvement in the properties of malleable iron, which has been brought about as a direct result of this policy, is set forth in a statement recently authorized by the association. Records of tests made in 1911 showed the average ultimate strength of malleable iron as manufactured to be about 39,000 lb. and the elongation under 5 per cent. A report made in September, 1920, showed an average ultimate strength of over 53,000 lb., and an average elongation of over 14 per cent. The report also showed that the result of this co-operative research work was not only to increase ultimate strength and elongation, but to increase the uniformity of the product.

Metal & Thermit Corporation

The Metal & Thermit Corporation has opened a branch office at 141 Milk street, Boston, Mass. Robert L. Browne is the New England district manager. O. E. Falls, who has had many years of experience in charge of foundry and thermit welding work at the Norfolk Navy Yard, Portsmouth, Va., has accepted a position with the Metal & Thermit Corporation, New York. Mr. Falls obtained his earlier foundry experience from positions held at the Norfolk & Western shops, Roanoke, Va.; the Richmond Locomotive Works, Richmond, Va.; the Pennsylvania Engineering Works, New Castle, Pa.; the Franklin Air Compressor Works, Franklin, Pa.; and the Seaboard Air Line shops, Portsmouth, Va. At the last mentioned company, Mr. Falls began his first thermit welding work. In 1905, he joined the Goldschmidt Thermit Company, New York, and in 1907, returned to the Norfolk Navy Yard and for ten years did all or supervised the thermit welding work of that company. In 1917, he became superintendent in the steel foundry of the Bay View Foundry Company, Sandusky, Ohio. Later he was appointed superintendent of the steel foundry of the Weatherley Steel Castings Company, Weatherley, Pa., and still later superintendent of the iron and brass foundry of the Gaskins Foundry Company, New Bern, N. C. When he accepted his present position with the Metal & Thermit Corporation, he was superintendent of the iron and brass foundry of the Manning Manufacturing Company, Rutland, Vt.

TRADE PUBLICATIONS

HANDBOOK FOR DRILLERS.—A 37-page booklet has been designed for students of drilling by the Cleveland Twist Drill Company, Cleveland, Ohio. It is in reality a thoroughly revised, rewritten and reillustrated edition of "Uses and Abuses of Twist Drills."

LIFTING JACKS.—The Duff Manufacturing Company, Pittsburgh, Pa., is distributing catalogue No. 104, a new 148-page book illustrating and describing the complete line of Duff lifting jacks. It includes jacks of all types for steam railway work—track jacks, car jacks, locomotive jacks, bridge jacks and journal box jacks.

LEATHER BELTING.—The manufacture and renovation of leather belting are treated in Catalogue No. 12 of the Consolidated Belting Company, Philadelphia, Pa. A valuable feature of the catalogue is a concise discussion of belting problems and their solution and formulae for calculating the proper sizes and speeds for belts.

LUBRICATION.—Technical discussion of lubrication and the use of lubricating oils in various industries form the subjects of the articles in the monthly publication of the Texas Company, New York City. This magazine is distributed without cost to those who are especially interested in the use and selection of lubricants.

THERMIT WELDING.—An instruction book, especially prepared for use by men actually performing thermit welding repairs in railroad shops, has recently been issued by the Metal & Thermit Corporation, New York. This booklet, which is known as Pamphlet No. 41, is of convenient pocket size for ready reference.

LATHE AND PLANER TOOLS.—A 32-page catalogue has been issued recently by the Ready Tool Company, Bridgeport, Conn., showing the various kinds and sizes of tools manufactured by this company. These tools include high-speed lathe centers; lathe, grinder and milling-machine dogs; lathe and planer tools, hold-downs, and belt sticks.

RADIAL DRILLS.—The Western Machine Tool Works, Holland, Mich., has recently issued catalogue No. 21, in which its line of plain and universal radial drills is fully described and illustrated. The special feature of these drills is the low hung drive in which the spindle driving gear is located at the lower end of the spindle just above the socket.

HOISTS.—The Wright Manufacturing Company of Lisbon, Ohio, manufacturers of high speed hoists, screws and differential blocks and steel trolleys, have issued an attractive new catalogue descriptive of their line. It contains much data of use to those interested in hoists and a portion of the catalogue is devoted to a discussion of the various types of hoists and the field of usefulness of each.

INSTRUCTION BOOK FOR RAILROAD SHOPS.—The Metal & Thermit Corporation, New York, has just issued a small Thermit railroad instruction book, No. 41, expressly prepared for use by men actually performing Thermit welding railroad repairs. The pamphlet is of a convenient pocket size and the instructions have been condensed into the smallest possible space consistent with clearness aand thoroughness.

SPANISH LEAFLET.—That the English-speaking race is not the only large user of thread-cutting machinery is indicated by the fact that the Landis Machine Company, Waynesboro, Pa., has issued recently a 16-page leaflet, in Spanish, describing Landis thread-cutting machinery. This leaflet is intended for distribution in Spain and South America and includes many illustrations of different types of machines, together with their descriptions, from the earliest days to the present time.

REILLY FEED WATER HEATER.—Bulletin No. 260 has been issued by the Griscom-Russell Company, New York, describing two types of Reilly feed water heaters. It is pointed out in the first part of the bulletin that the prime function of a boiler is to generate steam, not to heat water. Special emphasis is laid on the value of feed water heaters in saving fuel, increasing boiler capacity, reducing the cost of maintaining a boiler and increasing its life. A method of computing the actual saving resulting from the use of a feed water heater is given. Complete tables of dimensions for the different sizes of heaters are included in the

bulletin. The proper methods of installing Reilly heaters are shown in detail, together with the information required when ordering.

Radius Tools.—The advantages of standard radius lathe and planer tools are plainly indicated in a little booklet issued recently by the R. G. Smith Tool & Manufacturing Company, Newark, N. J. Illustrations are included showing how convex or concave surfaces of any standard radius can be machined by the use of special cutters. A holder is provided for the cutter, which may be used almost indefinitely, as it can be reground many times without altering the cutting radius.

Rail Welding.—The Metal & Thermit Corporation, New York, has issued a new and revised Thermit rail welding pamphlet, No. 39, which describes the various ways in which Thermit welding can be advantageously used for rail welding, such as for eliminating rail joints and track maintenance expense in ordinary paved track, for making low cost and low maintenance frogs and crossings, for repairing motor cases and truck frames and for welding steam railroad rails in paved streets or where main highways cross the tracks.

Tubular Steel Poles.—Bulletin No. 14-C of the National Tube Company, Pittsburgh, Pa., is an attractive 48-page booklet which sets forth the advantages of tubular steel poles. The application of this type of support to high automatic or manual signals, trolley wires, telegraph and telephone lines, transmission lines and lighting fixtures, is illustrated and described. A tabulation of sizes, weights, etc., facilitates the selection of the pole best suited for the particular service. The closing pages of the bulletin are devoted to tables, giving the properties of steel pipe.

Carbonfree Metals.—The Metal & Thermit Corporation, New York, has issued the fourth edition of its Thermit Carbonfree Metals and Alloys Pamphlet No. 20. The pamphlet, in addition to containing a detailed description of the properties and characteristics of the various carbonefree metals and alloys manufactured by this company, includes also for the first time an explanation of the advantages of using tungtabs or tablets of pure tungsten metal in the production of high speed steel and other alloys containing tungsten instead of using tungsten powder and ferro-tungsten.

Wrought-iron Pipe.—Bulletin No. 1, issued recently by the Reading Iron Company, Reading, Pa., is a finely illustrated 31-page bulletin describing wrought-iron pipe, both in manufacture and service. An interesting account is given of the origin and development of the wrought-iron industry. Illustrations and descriptions are given of the various processes entering into the manufacture of wrought-iron pipe, including the puddling process, manufacture of the skelp, and the different operations in making the final product. The advantages of wrought-iron pipe over steel pipe are commented upon, and the last few pages of the bulletin show some interesting examples of the use of wrought-iron pipe.

Die Blocks.—Catalogue No. 3 entitled "Die Blocks" has been issued by the Pennsylvania Forge Company, Philadelphia, Pa. The catalogue explains that quality and uniformity should be the first consideration in ordering die blocks. The first cost of the steel is negligible compared with the expense of sinking and the risk of cracking in hardening. It is stated that die blocks made by this company are made of acid open hearth steel in 10-ton furnaces, insuring uniformity of product. A description of the various grades of die blocks is given in the catalogue, together with recommended heat treatment. A complete table of the weights of die blocks is shown; also a table of draft angles for die sinkers.

Skin Sores and Boils.—"Causes of Skin Sores and Boils Among Metal Workers" is the title of a 51-page booklet issued recently by E. F. Houghton & Co., Philadelphia, Pa. One of the serious problems confronting the metal-cutting industries is that of boils and skin sores among operators, and this booklet presents the results of a complete investigation of the subject made by the Houghton research staff. The work is thoroughly practical and shows that wherever the suggestions for prevention of infection have been applied in a common sense manner, the infection has been cut down and in some cases eliminated. The investigation also showed no grounds for the widespread belief that cutting compounds are primarily responsible for the various forms of infection among metal-cutting operators.

Industrial Relations Work of Westinghouse Air Brake Company.—An attractive illustrated book describing the agencies that have been established to promote the general well-being of the employees and to facilitate pleasant, harmonious industrial relations, has recently been issued by the Westinghouse Air Brake Company as publication 9044. The efforts of this company to cooperate with its employees have extended over more than a half century. At present the company has an Industrial Relationship Committee, a pension system, a relief department, a workmen's compensation fund, Y. M. C. A. and Y. W. C. A. buildings and other social activities. All these are outlined in a manner that makes the book valuable to anyone interested in the subject of relation between employer and employee.

Magnesia Pipe and Boiler Covers.—The field for heat insulating coverings for pipes and boilers is covered in a thorough manner in an attractive booklet entitled "Defend Your Steam" published by the Magnesia Association of America, Philadelphia. Numerous accounts of tests and extracts from technical papers are given to show the efficiency of magnesia as insulating material. The process of manufacture from Dolomite rock is described and descriptions and illustrations of typical installations are given. The book contains tables showing the losses from bare steam pipes and the saving in fuel and in money effected by the use of magnesia insulation. The specifications of the Magnesia Association are included and charts are shown from which the thickness of covering for the maximum net saving can be obtained.

Leather Belting.—Bulletin No. 101, entitled "Standardized Leather Belting," and containing 96 pages, has been issued by the Graton & Knight Manufacturing Company, Worcester, Mass. The advantages of standardization, not only in the manufacture of leather, but power transmission belting, are explained and illustrations given of the kinds of belting used for different purposes. Among other sections of interest in the bulletin are two devoted to the machine and woodworking shops. In each case, full directions are given for ordering the best belts for the individual machines. The belt widths are shown, together with the horsepower transmitted under various conditions. The last few pages of the bulletin are devoted to different methods of lapping belts, rules for obtaining tension belts, and tables containing information of value to belt users.

Packless Valves.—Every engineer, architect, fitter and user of valves realizes the importance of eliminating leaks at valve handles. The actual expense of repacking a dozen or more valves on a system may not be in itself a big item, but when the repacking of important valves necessitates tying up part of the power house equipment the incidental cost is very high. Packless valves are coming into more common use and an effective form of this valve is described in an eight-page folder published by the Defiance Packless Valve Company, Chicago, Ill. This valve has a metal to metal seat with a non-rising double taper stem upheld by a spring. It is claimed to be non-leakable. Valves of this type are fully tested before shipment and may be used for low and high pressure steam, hot and cold water, oil and air, up to and over 2,000 lb. Among the advantages claimed for the Defiance Packless Valve are simplicity of design and construction, elimination of all packing and easy turning under high pressure.

Thermit Mill and Foundry Practice.—The Metal & Thermit Corporation, New York, has just issued the third edition of the Thermit welding pamphlet No. 17, for mill and foundry repairs. The new edition has been revised and brought up to date both as regards new practices recommended and illustrations showing recent interesting repairs on certain types of equipment which were executed since the publication of the former edition.

The pamphlet begins with a general discussion of the proper applications and fields for oxy-acetylene, electric and Thermit welding, respectively. It then describes in detail the methods to be followed and apparatus used in welding iron and steel sections in general. Later it outlines thoroughly special applications of Thermit welding, such as for crankshaft, pinion and roll repairs, and also for cast-iron welding. Not previously included in former editions of this pamphlet is a description of a new method of welding teeth in pinions. The pamphlet concludes by explaining the various applications of Thermit in foundry practice, such as for increasing the temperature of iron and steel, facilitating the introduction of other metals which it is desired to alloy for special purposes, keeping metal and risers liquid for a considerable period and making small steel castings.